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RDT&E PROJECT NO 1G643324D55603

USATECOM PROJECT NO 7-7-0888-01/02

INTEGRATED ENGINEERING AND SERVICE TESTS OF DUST CONTROL MATERIALS

FINAL REPORT

BY

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21 MARCH 1968

US ARMY
ARMOR & ENGINEER BOARD
FORT KNOX, KENTUCKY

US ARMY
GENERAL EQUIPMENT TEST ACTIVITY
FORT LEE, VIRGINIA

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DEPARTMENT OF THE ARMY
HEADQUARTERS, U. S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

AMSTE-GE

10 APR 1968

SUBJECT: Approved Final Report of Integrated Engineering and Service Tests of Dust Control Materials, RDTE Project No. 1G643324D-55603, USATECOM Project No. 7-7-0888-01/02

Commanding General
U. S. Army Materiel Command
ATTN: AMCRD-GS
Washington, D. C. 20315

1. References:

a. Letter, AMSTE-GE, U. S. Army Test & Evaluation Command, 23 Oct 67, subject: "Integrated Engineering and Service Test of Dust Control Materials, USATECOM Project No. 7-7-0888-01/02."

b. Department of the Army Approved Qualitative Materiel Requirement for Dust Control Materiel, 19 July 1966.

c. Approved Plan for Integrated Engineering and Service Tests of Dust Control Materials, USATECOM Project No. 7-7-0888-01/02, 5 July 67.

d. Pre In-Process Review (IPR) conference for Technical Characteristics, Engineering Concept and Design Characteristics on Distribution, Dust Control Material, DA Task 1G643324D59631, held at U. S. Army Mobility Equipment Research and Development Center on 20 March 1968.

2. Forwarded for information and appropriate action is the U. S. Army Test & Evaluation Command Approved Final Letter Report of the Integrated Engineering and Service Test of six different commercial-type dust palliative materials. This report covers test operations up until test termination on 24 October 1967. The test was terminated by this headquarters (reference 1a) because the six test materials fail to meet the performance requirements of the QMR (reference 1b).

3. This headquarters concurs in the statements made in the report except for two statements that require further clarification. Paragraph 3d(2) states that "All the test materials except Code F failed to perform

satisfactorily under ground vehicular traffic." Ground vehicular traffic in this case was only the vehicular traffic occurring at the test site. The QMR (reference 1b) requirement for the material to be effective, with only minor maintenance for one month in areas trafficked by ground vehicle or aircraft, requires clarification of the amount of traffic involved. This clarification is required before it can be clearly stated that the Code F material met the requirement. The second statement which requires further clarification is paragraph 8d, which states "the top opening-type drum be considered suitable for storage and handling of test materials when a polyethylene lining has been provided under the lid of drums containing emulsion-type materials." What is intended by this statement is that emulsion-type materials require a lining and should not come in direct contact with the drum. The storage and handling requirements of the QMR were not determined during this test. Information presented at the pre In-Process review on Distributor, Dust Control Material by USAMERDC personnel (reference 1d) was that the open top drum does not meet overseas shipment requirements.

4. This headquarters concluded at the time of test termination (reference 1a) that the materials have some limited use and that informal reports from Vietnam indicate use in that theater of several of the materials with varying degree of success. Analysis of the Engineering and Service Tests results indicate the Code F material ranks the highest and is considered to be the most effective of the materials tested. The Code A material ranks second to the Code F material and is considered to be the best of the emulsion-type materials.

5. This headquarters reiterates the conclusions made at the time of test termination:

a. It is concluded that the test materials are not suitable for army use in that they do not meet the qualitative material requirements as defined in the QMR.

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b. It is further concluded that the materials, specifically Code F and Code A may have some limited use.

FOR THE COMMANDER:

JAMES O. DAULTON
Colonel, GS
Director, General Equipment
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1 Incl
as (5 cys)

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DEPARTMENT OF THE ARMY 1LT Craig/726-3300/4-4054
UNITED STATES ARMY ARMOR AND ENGINEER BOARD
Fort Knox, Kentucky 40121

STEBB-EN-P 21 MAR 1968

SUBJECT: Final Report of Integrated Engineering and Service Tests of Dust Control Materials, RDT&E Project No 1G643324D55603, USATECOM Project No 7-7-0888-01/02

TO: Commanding General
US Army Test and Evaluation Command
ATTN: AMSTE-GE
Aberdeen Proving Ground, Maryland 21005

1. REFERENCES

a. USAARENBD Plan for Integrated Engineering and Service Tests of Dust Control Materials, USATECOM Project No 7-7-0888-01/02, 5 Jul 67.

b. Department of the Army Approved Qualitative Materiel Requirement for Dust Control Materiel, 19 July 1966.

c. Ltr, AMSTE-GE, Project No 7-7-0888/01/02, HQ USATECOM, 4 Nov 66, subject: Test Directive, USATECOM Project No 7-7-0888-01/02 Integrated Engineering/Service Test of Dust Control Materials, DA Project No 1V021701A046, w 9 incl.

d. Msg, TEC 6716, AMSTE-GE, HQ USATECOM, 27 Apr 67, subject: Amendment to Test Directive, USATECOM Project Number 7-7-0888-01/02, Integrated Engineering Test Service Test of Dust Control Materials, DA Project Number 1V021701A046.

e. Ltr, AMSTE-GE, HQ USATECOM, 23 Oct 67, subject: Integrated Engineering and Service Tests of Dust Control Materials, USATECOM Project No 7-7-0888-01/02.

f. Ltr, STEBB-EN-P, USAARENBD, 26 May 67, subject: Preliminary Guide Manual for the Use of Code A as a Dust-Control Agent, w 1 incl, and 1st Ind, AMSTE-GE, HQ USATECOM, 1 Jun 67.

g. Preliminary Guide Manual for the Use of Code A as a Dust-Control Agent, undated, USAEWES.

2. RESPONSIBILITIES

a. The Engineer Division, US Army Armor and Engineer Board (USAARENBD), Fort Knox, Kentucky, was responsible for preparation of the integrated test plan (reference 1a), test coordination, service test execution, and preparation of the final report.

b. The US Army General Equipment Test Activity (USAGETA), Fort Lee, Virginia, was responsible for preparation of the engineering tests included in the integrated test plan, execution of the engineering test, and preparation of the engineering test input for inclusion in the integrated final test report.

c. The US Army Engineer Waterways Experiment Station (USAEWES), Vicksburg, Mississippi, was responsible for providing test materials at the test sites (Eglin AFB, Florida; Dyess AFB, Texas; Fort Leonard Wood, Missouri); for support of the US Army General Equipment Test Activity in engineering test execution, and for support of the US Army Armor and Engineer Board in execution of the service test.

3. BACKGROUND

a. The immediate need for effective dust control materials in the theater of operations is readily apparent. In response to this requirement, the US Army Materiel Command RDT&E Project/Task No 1G6433'4D5603 provided for development of dust palliatives to fulfill the requirement specified in the QMR (reference 1b). The US Army Engineer Waterways Experiment Station was assigned this project/task as the developing agency. Through accelerated laboratory tests and analysis of numerous materials, USAEWES recommended as an interim measure six commercial products be included in an integrated engineering and service test (ES).

b. Six existing commercially-produced materials were evaluated on three selected sites. The test sites, each with different type soil, were selected by a team from the USAARENBD and USAEWES and were located at Eglin AFB, Florida (sand); Dyess AFB, Texas (clay); and Fort Leonard Wood, Missouri (silt).

c. The test was conducted under the authority contained in references 1c, d, and f.

d. The test was terminated on 24 Oct 67 (reference 1e) for the following reasons:

(1) All of the test materials failed under the C-130E aircraft and the CH-47A helicopter tests on one or more of the soil conditions.

(2) All of the test materials except Code F failed to perform satisfactorily under ground vehicular traffic.

(3) Codes D and F emplaced at the Eglin site, and Code D at the Dyess site failed to meet product specifications.

4. DESCRIPTION OF MATERIEL. The test items were six different commercial-type dust palliative materials.

a. CODE A. A clear, water-dispersed, air-drying adhesive. It is a polyvinyl acetate emulsion modified with plasticizers, surfactants, and other inorganic elements.

b. CODE B. A green-colored, water-dispersed, air-drying adhesive. The solids content is approximately 50 percent and consists primarily of synthetic rubber, resins, pigments, and fillers. A small amount of solvent, such as toluol and methyl alcohol, is present in concentrations of less than 5 percent each. The remainder of the solvent is water.

c. CODE C. An air-drying adhesive which is available in many colors and is water-dispersed. It is an elastomeric polymer emulsion containing a latex, sodium polyacrylate, kaolin pigment, and surfactants.

d. CODE D. A dark brown to black conventional slow-curing grade of cutback asphalt. The appropriate penetration asphalt cement (50) is liquified with petroleum solvents of low volatility.

e. CODE E. A light-grade oil containing approximately 70 percent of a high-boiling aromatic oil.

f. CODE F. A dark brown to black proprietary cutback asphalt product. It is synthesized from a low penetration grade (10-20) asphalt and selected solvents.

5. TEST OBJECTIVES

a. To determine the technical performance and safety characteristics of the dust control materials as described in the QMR and as indicated by the particular design, and to determine the suitability of the materials for Army use.

b. To determine the capabilities of the test items to meet dust control material requirements of the Department of Army Approved QMR for Dust Control Materiel.

c. To determine the capability of the USAEWES - procured asphalt distributor and any available truck-mounted asphalt distributor in the Army inventory to meet the performance requirements for dispersing in the DA Approved QMR.

d. To determine the adequacy of the USAEWES preliminary guide manual for use with Code A test material.

e. To determine the suitability of top opening-type drums during storage and handling operations.

6. SUMMARY OF RESULTS. Test results are based on testing conducted during the period April - October 1967. The test items met criteria (inclosure 3) except as otherwise indicated below:

a. Safety (ET). Evaluations of the developer's safety statement; the OSG toxicity clearance for testing; laboratory test results of flash point, water extractables from dried palliatives, and changes in gage pressure with increases in temperature; and experience during use in engineering tests show that the six palliatives are safe for field use when the following safety findings are considered and observed:

(1) All of the liquid palliatives should be handled with caution, in that skin contact, ingestion, and inhalation of fumes should be avoided; therefore, adequate clothing, supplemented by the use of barrier creams on uncovered skin, should be worn by personnel during application, and the earliest possible removal of palliatives from the skin by washing is recommended.

(2) Code F has a flash point below 175°F. and must be considered a flammable liquid (para 1.1, inclosure 4), while Code E and Code D will burn but are not easily ignited. Code A, Code B, and Code C are non-flammable water-dispersed liquids. None of the materials were considered fire hazards after drying on soil surfaces.

(3) Calculations combining laboratory tests of vapor pressure and densities with considerations of reduced atmospheric pressures expected at 40,000 feet altitude result in a required rigid-container strength of at least 20 pounds per square inch for safe air transport.

(4) Laboratory analyses of water decanted from dried palliative samples showed that only small quantities of the dried materials are borne away by water, indicating that these materials as applied in the field would be expected to have little, if any, adverse effects on water supplies, livestock, or agricultural enterprises.

b. Weight and Volume Characteristics (ET). Laboratory determinations of the specific gravity were used as a basis for calculating the weight and volume characteristics of each of the six candidate materials to determine relationships to the maximum allowed application rates under the QMR. The QMR maximum weight allowance of 3 pounds per square yard limits the volume of each of the materials to less than 0.40 gallons per square yard. Volumes ranged from 0.33 gal/sq yd of basic material for Code A (the heaviest) to 0.38 gal/sq yd of basic material for Code F (the lightest). None of the materials diluted with water required as much as 2.0 gallons of water per square yard for dilution before application.

c. Corrosion Tests (ET). Tests were not completed prior to test termination and results were inconclusive.

d. Drying Tests (ET). Although test data were insufficient to provide a basis for statistically valid conclusions, studies of loss of weight curves coupled with subjective observations of dryness indicate the following:

(1) The water-dispersed polymers, Code A, Code B, and Code C, formed films on sunlit dry soils within approximately 4 hours after application but required additional curing time to completely harden.

(2) The petroleum-base materials did not behave alike. Code F formed a surface film in approximately 5 hours but required more time to harden. Code D required approximately 48 hours to cure enough to permit contact, and Code E remained "oily" indefinitely.

e. Wind Erosion Tests (ET). Tests were not completed. Available data indicating the percentages of dust palliation for three types of dry soils are presented in Table I below.

TABLE I

PERCENT DUST PALLIATION BY WEIGHT
(Average of Five Samples Each)

Test Material	Dry Sand	Dry Clay	Dry Sandy Clay
Code A	99.8%	85.2%	99.7%
Code B	100.0%	96.8%	98.4%
Code C	99.9%	85.4%	98.4%
Code D	91.1%	93.9%	92.8%
Code E	99.8%	*26.0%	94.8%
Code F	98.6%	97.1%	98.4%

*Resultant due to poor coverage because of lack of penetration in the dry soil.

f. Storage Tests (ET). No storage test results were obtained prior to test termination.

g. Freezing Point Tests (ET). Results of laboratory freezing point determinations are shown in Table II below.

TABLE II

FREEZING POINTS
(Average of Two Tests Each)

Test Material	Degrees F
Code A	30.0
Code B	20.0
Code C	29.0
Code D	-57.0
Code E	-46.0
Code F	-50.0

The above results show that the water-dispersed palliatives can be expected to be difficult to store and use in intermediate and cold climates.

h. Soil Characteristics (ET). At each test site, the following data were collected: water content, dry density, surface water content, airfield index, gradation curves. (See pages 2 through 15, inclosure 1.)

i. Emplacement (ST).

(1) Site preparation was required to bring the medium-lift airfields to an acceptable testing condition.

(a) At Eglin AFB, grading of the site to clear vegetation and an existing residue of dust palliative was performed by Base Engineer personnel.

(b) At Dyess AFB, grading and rolling of the site to clear vegetation and to prepare the soil surface were performed by Post Engineer personnel and attached troops.

(2) The test materials were received at each test site as indicated on page 1, inclosure 1.

(a) The Code F material used at Eglin AFB (page 38, inclosure 1) failed to meet specifications and was not representative of the proprietary product.

(b) The Code D material used at Eglin AFB (page 37, inclosure 1) failed to meet ductility requirements on the 100 penetration residue. On the basis of the analysis, the material is considered to be a borderline Code D cutback asphalt.

(c) The Code D supplied to Dyess AFB (page 39, inclosure 1) also is considered to be a borderline material in that it failed to meet viscosity and float-test requirements.

(3) The following difficulties were encountered in the supply of the test materials.

(a) A solid film formed on the surface of the test material in the open-top drums of Code A supplied to Fort Leonard Wood because there were no plastic liners under the lids. Removal of this film delayed loading operations.

(b) The open-top drums of Code C supplied to Dyess AFB and Fort Leonard Wood were difficult to reseal because several of the lids were warped when received at the test sites.

(c) The open-top drums of Code B supplied to Dyess AFB were difficult to reseal because several of the lids were warped when received at the test site.

(d) The bung-type drums of Code E supplied to Eglin AFB were easily caved in and/or punctured. The 3-inch-diameter opening in the top of the drums caused difficulty in unloading the test materials from the drums. A 1-1/2-inch-diameter nozzle was inserted into the drums to pump out the materials.

(4) The equipment used in emplacement was as follows:

(a) A Code H 2-1/2-ton truck with a 900-gallon capacity procured by USAEWES was used for material distribution. It has the following attachments: material heater, material pump, and adjustable (1-20 feet) spray bar. The dispersing rate of material was set on dials inside the cab which were linked to the speed of the distribution. (See page 16, inclosure 2.)

(b) A military distributor was procured from the Army inventory. This item was a 2-1/2-ton truck with a capacity of 900 gallons. It has the following attachments: material heater, material pump, and a 12-foot spray bar. The dispersing rate of the material could not be linked to the speed of the distributor. (See page 8, inclosure 2.)

(c) A 2-1/2-ton truck with a capacity of 1,200 gallons procured by USAEWES was used in the prewetting operations. It had the following attachments: towed spray bar unit, 20-foot spray bar. It had no gages for material usage. (See page 7, inclosure 2.)

(5) The following difficulties were encounted with the test materials and dispersing equipment in the emplacement of the test materials.

(a) At Eglin AFB, the tire tracks of the asphalt distributor created many surface irregularities in the sand. This condition resulted in weak areas in the emplaced film-forming materials. (See page 1, inclosure 2.) A chain drag was placed behind the distributor wheels to reduce rutted areas; however, its smoothing effect was negligible. (See page 16, inclosure 2.)

(b) At Dyess AFB, excessive maneuvering of the asphalt distributor was required due to site restrictions (culvert).

(c) At Fort Leonard Wood, considerable rolling throughout emplacement operations was required due to the ease with which surface irregularities were formed in the silt with the various types of traffic. Rocks and roots added greatly to the surface roughness.

(d) At each test site, all of the emulsion materials temporarily clogged the spraying apparatus of the asphalt distributor. (See page 36, inclosure 1.) In using the emulsion materials, the asphalt distributor remained operational for approximately 5 hours, emplacement involving approximately 12,000 yd^2. Beyond these limits, clogging of the spraying apparatus is likely to occur. The asphalt materials contained lubricating qualities; therefore, no clogging occurred. With emulsion materials, modification of the pump design for external lubrication and frequent cleaning are required on the distributor.

(e) After emplacing the emulsion materials, the dispersing equipment must be thoroughly flushed; otherwise, material left in the distributor will set up and cause failure of the pump and spraying systems. Also, an accumulation of the materials build up and eventually break off and clog the spray apparatus. (See page 35, inclosure 1.)

(f) It was necessary to made a modification to the pump system of the truck-mounted asphalt distributor. The bushings in the pump of a conventional asphalt distributor are lubricated by the asphalt materials being dispersed. Since the emulsion materials do not have any lubricating capability, it was necessary to install fittings and lines for furnishing grease to the pump shaft bushings. (See page 40, inclosure 1.)

(6) The emplacement data and task structure employed are contained in pages 16 through 29, inclosure 1.

(7) Each material was tested for operational usability 4 hours after emplacement. An automobile was driven on the runway area and the condition of the shoulder was examined. Three of the test materials were not operationally usable within 4 hours after application. (See para 1.2, inclosure 4.)

(a) At Eglin AFB, Code F required 1 day to cure in the shoulder area and 4 days to cure in the runway area. Several puddles remained on the shoulder after 11 days and on the runway after 22 days.

(b) At Eglin AFB, Code D required approximately 34 hours to cure.

(c) At Dyess AFB, Code B required approximately 48 hours to cure.

(d) At Fort Leonard Wood, Code B and Code F required approximately 48 hours to cure.

(8) Test material cost per square yard was as follows:

(a) Code A, $0.36

(b) Code B, $0.96

(c) Code C, $0.37

(d) Code D, $0.05

(e) Code E, $0.10

(f) Code F, $0.10

Above costs do not include cost of application equipment which was negligible. Code B exceeded the maximum allowable cost of $0.50 per square yard. (See para 1.5, inclosure 4.)

j. Operational Effectiveness - Air Force C-130E Aircraft (ST).

(1) There were two landings and takeoffs at Eglin AFB and one landing and takeoff at Fort Leonard Wood. Because the aircraft was taxied to the test site at Dyess AFB, no landings and takeoffs were required.

(2) The C-130E aircraft was taxied to the edge of the runway and placed at varying angles (90° at Eglin AFB, 37° at Dyess AFB, 37° at Fort Leonard Wood) to the centerline with the tail extending over the treated section to be air-blasted. (See page 2, inclosure 2.) With the 37° angle, more of the material was exposed to the blast. The aircraft maintained each of the following conditions for 1 minute:

(a) Condition 1 - Ground Idle 18° throttle

(b) Condition 2 - 25 Percent Full Power 36° throttle

(c) Condition 3 - 50 Percent Full Power 54° throttle

(d) Condition 4 - 75 Percent Full Power 72° throttle

(e) Condition 5 - Full Power 90° throttle

(f) Condition 6 - Power Check Ground Idle to Full Power

(3) The following failures occurred in the test materials. (See para 1.3, inclosure 4.)

(a) At Eglin AFB, each emulsion-type test material peeled, and each asphalt-type test material eroded when subjected to propwash.

(b) At Dyess AFB, Code B and Code C peeled, and Code F, Code E, and Code D eroded when subjected to propwash.

(c) At Fort Leonard Wood, each emulsion-type test material peeled, and each asphalt-type test material eroded when subjected to propwash.

(4) The following list ranks the materials from most effective to least effective during aircraft operations. (See pages 30 and 31, inclosure 1.) Slightly damaged areas may be repaired in 1 hour or less. Moderately damaged areas required an hour or more to repair. Severly damaged areas are considered unrepairable.

(a) At Eglin AFB (Sand)

1. Code A Slight damage

2. Code C (light) Slight damage

3.	Code F	Moderate damage
4.	Code D	Moderate damage
5.	Code E	Moderate damage
6.	Code C (dark)	Severe damage
7.	Code B	Severe damage

(b) At Dyess AFB (Clay)

1.	Code A	No damage
2.	Code F	Slight damage
3.	Code D	Moderate damage
4.	Code E	Moderate damage
5	Code C	Moderate damage
6.	Code B	Severe damage

(c) At Fort Leonard Wood (Silt)

1.	Code F	Slight damage
2	Code D	Moderate damage
3.	Code E	Moderate damage
4.	Code A	Moderate damage
5.	Code B	Severe damage
6.	Code C	Severe damage

(5) At Eglin AFB, Code C appeared dark green in the east section of the treated area and light green in the west section. (See page 23, inclosure 1.) There was no outstanding change in the soil composition (see pages 2 through 6, inclosure 1) or emplacement rates (see page 17, inclosure 1). Under the C-130E propwash, the light green Code C was only slightly damaged. (See page 31, inclosure 1.) No explanation can presently be offered for the behavior of this test material.

(6) Data accumulated from pilot reports have been incorporated in the above test results.

k. Operational Effectiveness - Army Helicopter (ST).

(1) The CH-47A Helicopter performed test conditions (below) 1, 2, 3, and 8 over the shoulder area; conditions 4, 5, 6, and 7 were performed on the runway. (See page 3, inclosure 2.)

(a) Condition 1 - Steep approach to 10-foot hover (hover 5 min)

(b) Condition 2 - Land from 10-foot hover

(c) Condition 3 - Takeoff from hover

(d) Condition 4 - Full flare landing to ground

(e) Condition 5 - Maximum performance takeoff from ground

(f) Condition 6 - Running landing

(g) Condition 7 - Ground taxi maneuver

(h) Condition 8 - Hover (5-min) over area of taxi maneuvers and over edge of treated surface.

(2) The following failures occurred in the test materials. (See para 1.3, inclosure 4.)

(a) At Eglin AFB, Code B and Code C peeled and Code E eroded when subjected to rotor downwash; Code A, Code F, and Code D were slightly damaged.

(b) At Fort Leonard Wood, Code B and Code C peeled, Code A billowed, and Code D, Code E, and Code F eroded when subjected to rotor downwash.

(3) The following lists rank the materials, from most effective to least effective, during helicopter operations. (See pages 30 and 32, inclosure 1.)

(a) At Eglin AFB (Sand)

1.	Code A	Slight damage
2.	Code F	Slight damage
3.	Code D	Moderate damage
4.	Code E	Moderate damage
5.	Code B	Severe damage
6.	Code C	Severe damage

(b) At Dyess AFB (Clay). As a result of heavy rainfall damage, all of the test materials were removed so that normal aircraft operations could resume at the test site. Consequently, the helicopter operations were cancelled.

(c) At Fort Leonard Wood (Silt)

1.	Code F	Slight damage
2.	Code E	Moderate damage
3.	Code A	Moderate damage
4.	Code D	Moderate damage
5.	Code C	Severe damage
6.	Code B	Severe damage

(4) The following list ranks the test materials from most effective to least effective during the helicopter operations involved in the 3-month evaluation at Eglin AFB. Codes C, D, and E materials were not exposed to the rotor downwash because of inclement weather and scheduling difficulties. Similar 3-month evaluations were not held at the other sites because of termination of testing.

(a) Code F — Shoulder area - no damage

(b) Code A — Shoulder area - previously damaged areas expanded

(c) Code B — Severe damage

(5) Data accumulated from pilot reports have been incorporated in the above test results.

m. Maintainability (ST).

(1) The only difficulty experienced during repair operations was the frequent clogging of the patching apparatus. This problem was solved by running water through the lines and cleaning the compressor filter. (See page 4, inclosure 2.)

(2) Code B and Code C failed to perform the dust control function in the maintained areas. The remaining test materials were effectively maintained.

(3) The amount of man-hours and dispersing equipment hours for maintenance operations is listed on page 33, inclosure 1.

n. Reliability (ST).

(1) Each material was tested for effectiveness in areas trafficked by ground vehicles for 1 month.

(2) Daily vehicular traffic on an access road near the test sites at both Dyess AFB and Fort Leonard Wood was observed during the first 15-20 days of testing.

(3) The following lists rank the materials from most effective to least effective during vehicular operations. (See para 1.6, inclosure 4.)

(a) Dyess AFB

1.	Code F	Slight damage
2.	Code D	Moderate damage
3.	Code A	Moderate damage
4.	Code E	Moderate damage
5.	Code C	Severe damage
6.	Code B	Severe damage

(b) At Fort Leonard Wood

1.	Code F	No damage
2.	Code A	Slight damage
3.	Code E	Slight damage
4.	Code D	Slight damage
5.	Code B	Moderate damage
6.	Code C	Moderate damage

(4) At Eglin AFB within 3 days after emplacement, ants and vegetation had pushed through the film of Code A, B, and C test materials creating ruptured areas. (See para 2.1, inclosure 4.)

(5) The test material, Code A became tacky when the surface temperature reached an average of 120°F. The tackiness interfered with the operational effectiveness only when objects remained in a stationary position for about 15 minutes and then moved. (See para 2.2, inclosure 4.)

(6) The test materials, Code B, C, D, E, and F were no longer operationally usable after being subjected to 3.04 inches of rainfall within 11 hours on 11 and 12 June at Dyess AFB. Code A appeared operationally usable after the rainfall. (See page 34, inclosure 1, and para 1.4, inclosure 4.)

(7) The test materials were removed 3 to 4 days following the heavy rainfall at Dyess AFB. During this period, the weather was very dry with temperatures in the 90° - 95°F range. As the

emulsions were removed, the soil under the films was still very moist; therefore, any bonding between the film and soil was practically nonexistent.

o. Human Factors Engineering (ST).

(1) Code C emitted fumes and vapors which were irritating to the personnel involved in the loading operations.

(2) Although they were not harmful, the emulsion materials Code A, B, and C were difficult to remove from clothing and/or skin.

(3) When Code E came in contact with the skin, a slight irritation was experienced.

p. Training (ST).

(1) Personnel possessing the knowledge and skills required by the MOS 51A10 (Construction Helper), 62B30 (Engineer Equipment Repairman), 62E20 (Grader Operator), and 64B20 (Heavy Vehicle Driver) were able to prepare the test site and emplace and maintain the test materials. Cited MOS are pertinent to an Engineer Construction Battalion and Light Equipment Company.

(2) No special training was required.

q. Technical Manuscripts and Manuals (ST).

(1) Applicable portions of TM 5-366, Planning and Design for Rapid Airfield Construction in the Theater of Operations, Nov 65, was used as a guide throughout testing.

(2) With the exception of minor changes recommended in correspondence (reference 1f) the USAEWES Preliminary Guide Manual for the Use of Code A as a Dust-Control Agent (reference 1g) is considered a suitable interim publication for use with Code A test material.

(3) Publications pertinent to the other test materials were not received.

r. Safety Confirmation (ST).

(1) Codes D, E, and F are flammable liquids and must be applied away from spark or flame. (The safety requirements of the DA Approved QMR, para 2.3, inclosure 3, were not met in this respect.) None of the palliatives were considered fire hazards after drying on soil surfaces.

(2) All of the liquid palliatives should be handled with caution in that skin contact, ingestion, and inhalation of fumes should be avoided. Adequate clothing, supplemented by the use of barrier creams on uncovered skin, should be worn by personnel during application and the earliest possible removal of palliatives from the skin by washing is recommended. Eye goggles should be worn during application phase. Once the materials have been emplaced and cured, the toxicity is considered minimal.

(3) The QMR safety requirements (para 2.2, inclosure 3), are considered met.

7. CONCLUSIONS. The US Army Armor and Engineer Board concludes that:

a. All six of the test dust control materials are unsuitable for Army use in that each material failed to meet two or more essential requirements of the Department of the Army Approved QMR for Dust Control Material.

b. The USAEWES-procured asphalt distributor is capable of adequately dispersing all test materials provided that:

(1) Fittings and lines are installed to furnish grease to the pump shaft bearings.

(2) Equipment is thoroughly cleaned and flushed after emplacing emulsion-type materials to prevent setup of materials and failure of pumps and spray systems.

c. The USAEWES preliminary guide manual is adequate as an interim publication for use with Code A test material.

d. The top opening-type drums are suitable during storage and handling of test materials; however, with emulsion-type materials, a polyethylene liner under the lid is required.

8. RECOMMENDATIONS. The US Army Armor and Engineer Board recommends that:

STEBB-EN-P
SUBJECT: Final Report of Integrated Engineering and Service Tests of Dust Control Materials, RDT&E Project No 1G643324D55603, USATECOM Project No 7-7-0888-01/02

a. All six test materials be considered unsuitable for Army use pending correction of all deficiencies and as many as practicable of the shortcomings contained in inclosure 4.

b. The distributor be modified to ensure lubrication of the pump shaft bearings during application of dust control materials.

c. The USAEWES preliminary guide manual be considered a suitable interim publication for use with Code A test material.

d. The top opening-type drums be considered suitable for storage and handling of test materials when a polyethylene lining has been provided under the lid of drums containing emulsion-type materials.

e. Any future development of dust control materials incorporate correction of all deficiencies and as many as practicable of the shortcomings contained in inclosure 4.

5 Incl
1. Test Data
2. Photographs
3. Findings
4. Deficiencies and Shortcomings
5. Distribution List

MARSHALL WALLACH
COL, Armor
President

TEST DATA

SUPPLY OF TEST MATERIALS

SITE	MATERIAL	MODE OF SUPPLY	QUANTITY RECEIVED
EGLIN AFB	CODE A	Open-Top Drum**	44 Drums
	CODE B	Open-Top Drum*	44 Drums
	CODE C	Open-Top Drum	44 Drums
	CODE D	Bulk (unheated) in Truck, Tanker	3,759 Gal
	CODE E	Bung-Type Drum	72 Drums
DYESS AFB	CODE A	Open-Top Drum**	51 Drums
	CODE B	Open-Top Drum*	51 Drums
	CODE C	Open-Top Drum	52 Drums
	CODE D	Bulk (heated) in Truck, Tanker	4,014 Gal
	CODE E	Bulk (unheated) in Truck, Tanker	5,000 Gal
	CODE F	Bulk (heated) in Truck, Tanker	5,457 Gal
FORT LEONARD WOOD	CODE A	Open-Top Drum	51 Drums
	CODE B	Open-Top Drum*	51 Drums
	CODE C	Open-Top Drum	51 Drums
	CODE D	Bulk (heated) in Truck, Tanker	4,030 Gal
	CODE E	Bulk (heated) in Truck, Tanker	4,000 Gal
	CODE F	Bulk (heated) in Truck, Tanker	4,200 Gal

NOTE: A drum contains approximately 50 gallons.
*Completely lined with polyethylene
**A sheet of polyethylene was under lid

Incl 1

USAE WATERWAYS EXPERIMENT STATION

RESULTS OF SOIL TESTS FOR USATECOM PROJECT NO. 7-7-0888-01/02 (INTEGRATED ENGINEERING AND SERVICE TESTS OF DUST-CONTROL MATERIALS)

EGLIN AFB, FLORIDA
APRIL 1967

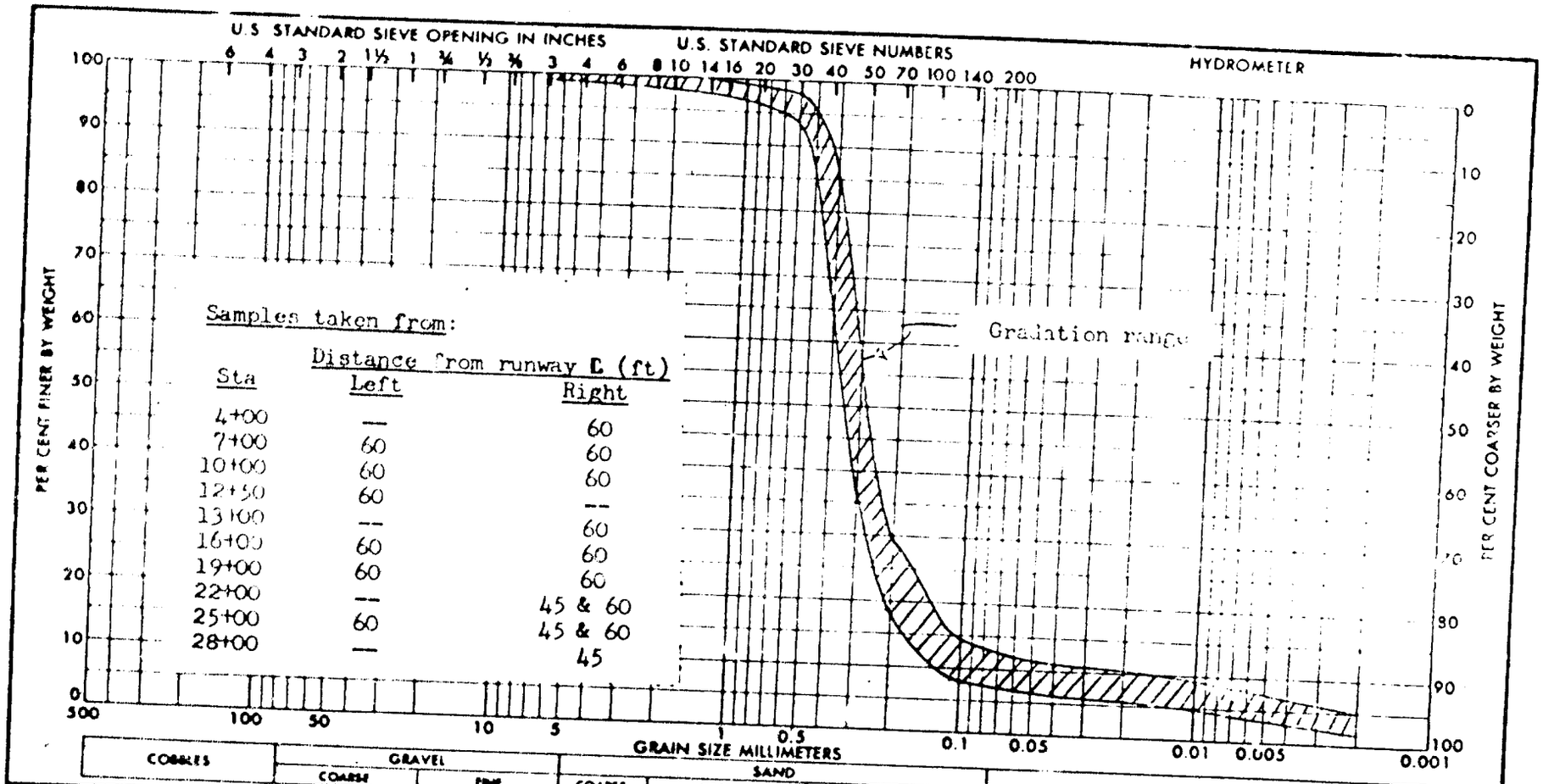
Station	Sample Location*	Sample from ½-in. to 3½-in. Depth: Water Content %	Sample from ½-in. to 3½-in. Depth: Dry Density lb/cu ft	Surface Water Content** %	Airfield Index at Depth (in.) of: 0	2	4	6	8	10	12
0+00	1	6.2	109.5	-	0	2	3	5	6	7	8
	2	6.9	111.4	-	2	13	15+				
	3	10.8	116.7	-	2	5	5	7	10	13	13
	4	11.8	89.1	-	0	1	4	8	10	11	12
1+00	1	9.6	97.7	-	0	1	4	5	8	11	12
	2	10.3	115.1	-	4	14	14	15+			
	3	9.1	116.7	-	5	15+					
4+00	1	4.2	116.1	0.1	5	15+					
	2	9.5	118.3	1.1	1	6	15+				
	3	10.6	118.0	1.3	4	8	11	15+			
	4	5.3	101.2	0.8	1	2	5	8	9	10	11
7+00	1	6.6	110.9	0.6	0	3	7	9	12	13	14
	2	10.5	114.7	1.1	1	5	9	15+			
	3	10.7	115.5	1.0	1	10	15+				
	4	5.9	106.9	0.6	1	5	9	11	13	13	14
10+00	1	6.4	110.7	0.7	0	3	7	10	14	15+	
	2	5.8	118.7	0.9	4	15+					
	3	11.2	115.8	1.2	7	15+					
	4	4.1	109.2	0.8	1	6	12	15	15+		

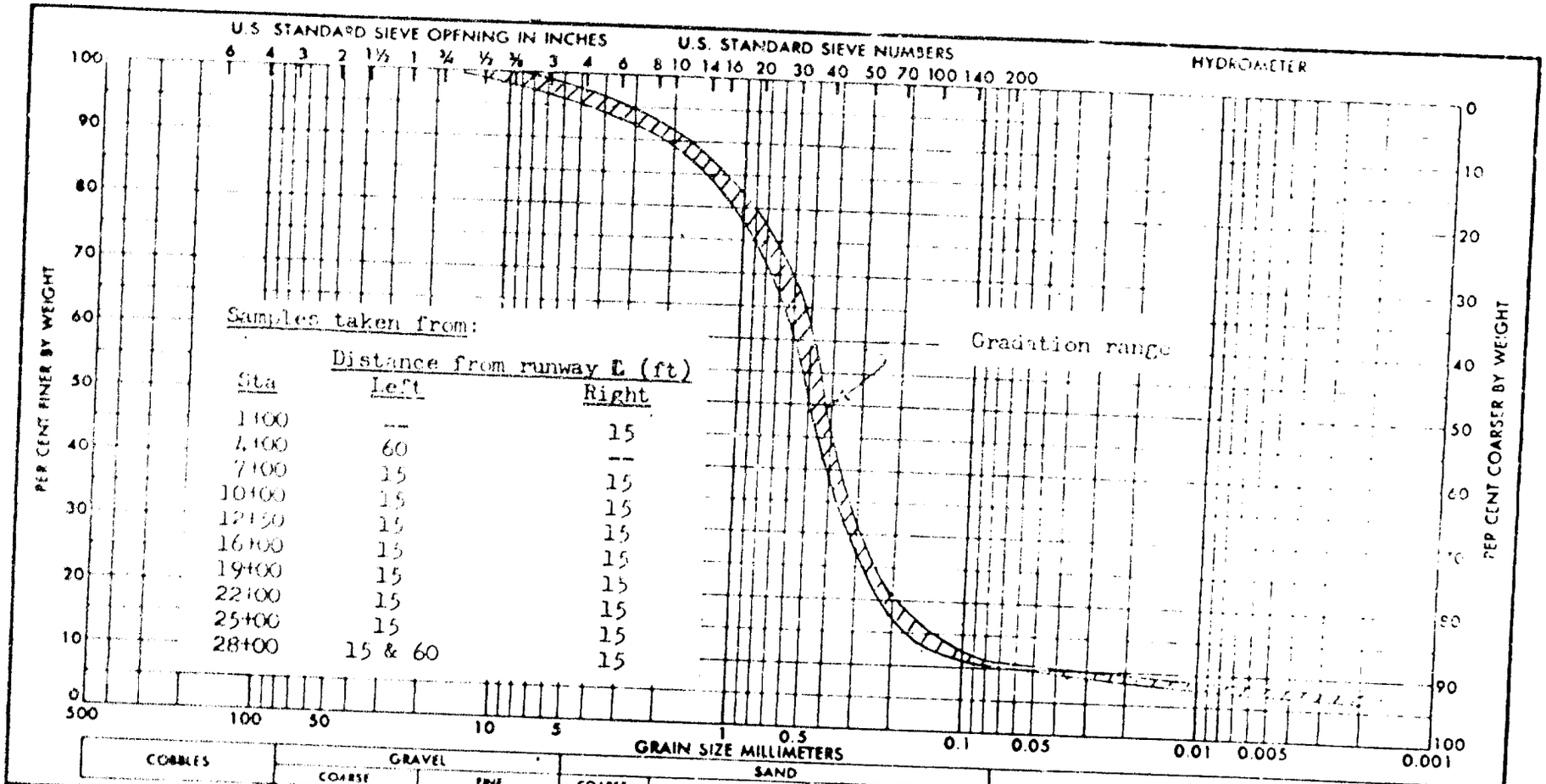
Station	Sample Location*	Sample from ½-in. to 3½-in. Depth: Water Content %	Sample from ½-in. to 3½-in. Depth: Dry Density lb/cu ft	Surface Water Content** %	Airfield Index at Depth (in.) of: 0	2	4	6	8	10	12
12+50	1	4.9	107.8	1.8	0	2	7	13	15	15+	
	2	5.6	116.3	3.2	15+						
	3	11.4	117.5	0.7	3	6	15	15+			
	4	5.5	107.9	0.5	1	2	4	5	7	9	10
16+00	1	4.0	112.9	0.5	0	1	5	9	14	15	15+
	2	8.6	114.8	1.8	8	15+					
	3	8.2	119.9	3.1	15	15+					
	4	4.6	105.8	0.2	1	3	6	9	10	10	10
19+00	1	5.6	113.6	0.3	0	3	9	14	15+		
	2	8.7	122.0	2.7	15+						
	3	10.7	119.9	5.6	14	15+					
	4	5.3	110.2	0.3	1	3	6	9	11	14	14
22+00	1	5.8	126.0	0.5	1	15+					
	2	9.3	114.3	2.7	15+						
	3	8.2	112.3	1.9	15+						
	4	5.9	112.4	0.2	0	3	9	11	14	15	15+
25+00	1	4.5	113.1	0.3	0	2	4	9	13	15	15+
	2	10.1	122.2	3.6	15+						
	3	7.5	118.5	1.9	15+						
	4	4.2	105.1	0.1	0	3	5	8	12	14	14
28+00	1	10.5	111.5	0.1	13	15	13	14	14	15+	
	2	8.8	121.1	1.7	15+						
	3	8.5	115.6	1.5	15+						

* Legend for sample location is as follows:

Sample Location No.	Distance and Position from Runway Center Line
1	60 ft left
2	15 ft left
3	15 ft right
4	60 ft right

** Surface water contents were taken from 0- to $\frac{1}{2}$-in. depth immediately prior to dust-control treatment.


U.S STANDARD SIEVE OPENING IN INCHES
U.S. STANDARD SIEVE NUMBERS
HYDROMETER
PER CENT FINER BY WEIGHT
PER CENT COARSER BY WEIGHT
Samples taken from:
Distance from runway ℄ (ft)
Sta Left Right
4+00 — 60
7+00 60 60
10+00 60 60
12+50 60 —
13+00 — 60
16+00 60 60
19+00 60 60
22+00 — 45 & 60
25+00 60 45 & 60
28+00 — 45
Gradation range
GRAIN SIZE MILLIMETERS
COBBLES
GRAVEL
COARSE
FINE
SAND
COARSE
MEDIUM
FINE
SILT OR CLAY
SAMPLE NO
ELEV OR DEPTH
CLASSIFICATION
NAT W%
LL
PI
0 to 5 in.
silty sand (SM)
(Non-Plastic)
GRADATION CURVES
PROJECT USATECOM 7-7-0[illegible]-01/02 (Integrated ET/ST of Dust-Control Materials)
AREA Eglin AFB, Florida
BORING NO
DATE April 1967
ENG FORM 2087
1 MAY 63
REPLACES WES FORM NO. 1241, SEP 1962, WHICH IS OBSOLETE
U.S. GOVERNMENT PRINTING OFFICE



SAMPLE NO	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
	0 to 5 in.	clayey sand (SP-SC)		(Ranges) 31-33	15-16	15-18
				(Averages) 32	15	17

GRADATION CURVES

PROJECT USATEC 7-7-0[illegible]-01/02 (Inte-grated ET/ST of Dust-Control Materials)

AREA Eglin AFB, Florida

BORING NO

DATE April 1967

ENG FORM 2087 1 MAY 63 REPLACES WES FORM NO 1241, SEP 1962, WHICH IS OBSOLETE

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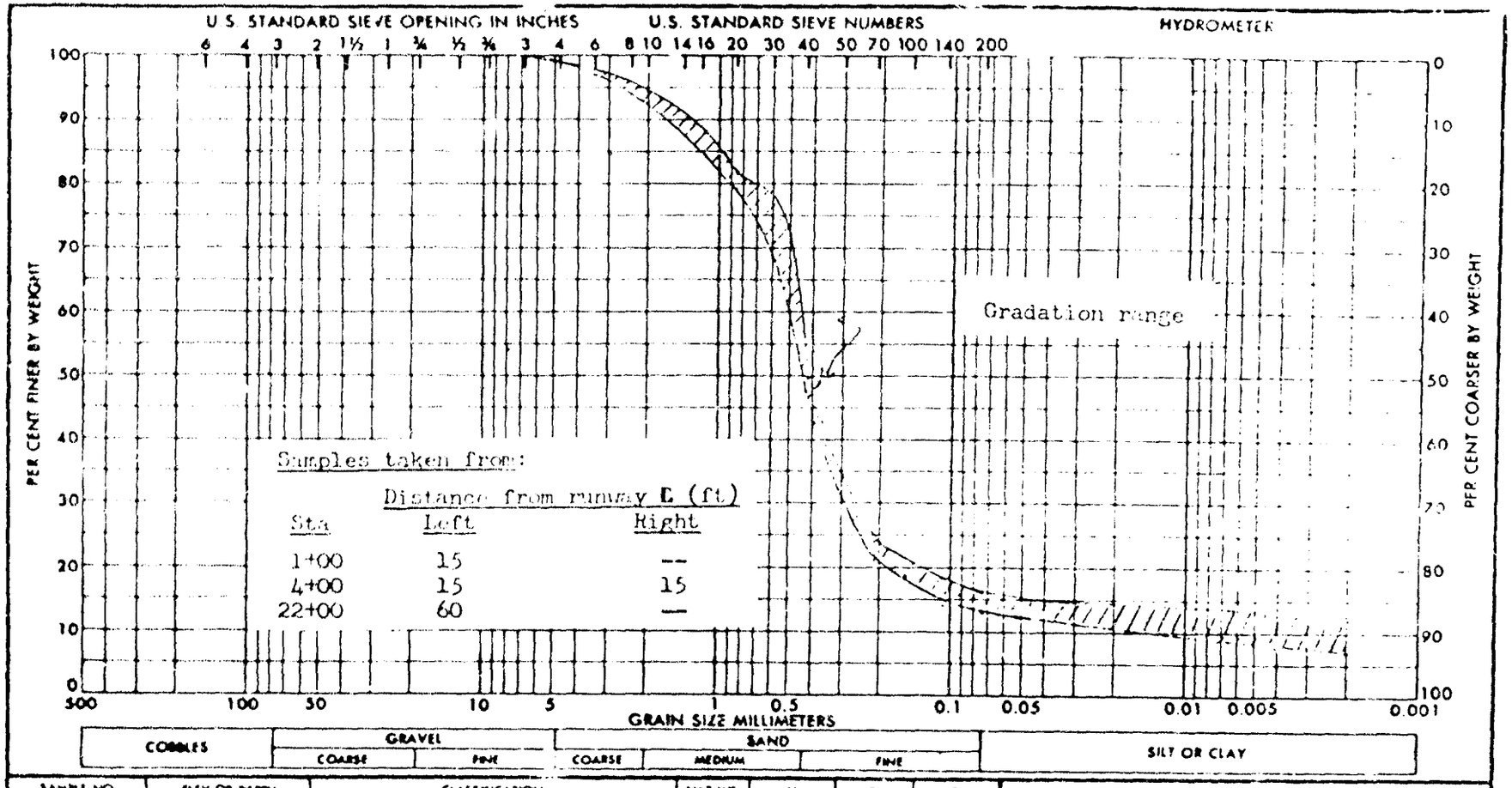


SAMPLE NO	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
	0 to 5 in.	clayey sand (SC)		(Ranges)		
				26-28	13	13-15
				(Averages)		
				27	13	14

GRADATION CURVES

PROJECT USATECOM 7-7-0898-61/02 (Integrated ET/ST of Dust-Control Materials)

AREA Eglin AFB, Florida

BORING NO

DATE April 1967

ENG FORM 2087 1 MAY 63 REPLACES WES FORM NO 1241, SEP 1962, WHICH IS OBSOLETE.

U.S. GOVERNMENT PRINTING OFFICE 1963 OF—709-128

USAE WATERWAYS EXPERIMENT STATION

RESULTS OF SOIL TESTS FOR USATECOM PROJECT NO. 7-7-0886-01/02 (INTEGRATED ENGINEERING AND SERVICE TESTS OF DUST-CONTROL MATERIALS)

DYESS AFB, TEXAS
MAY-JUNE 1967

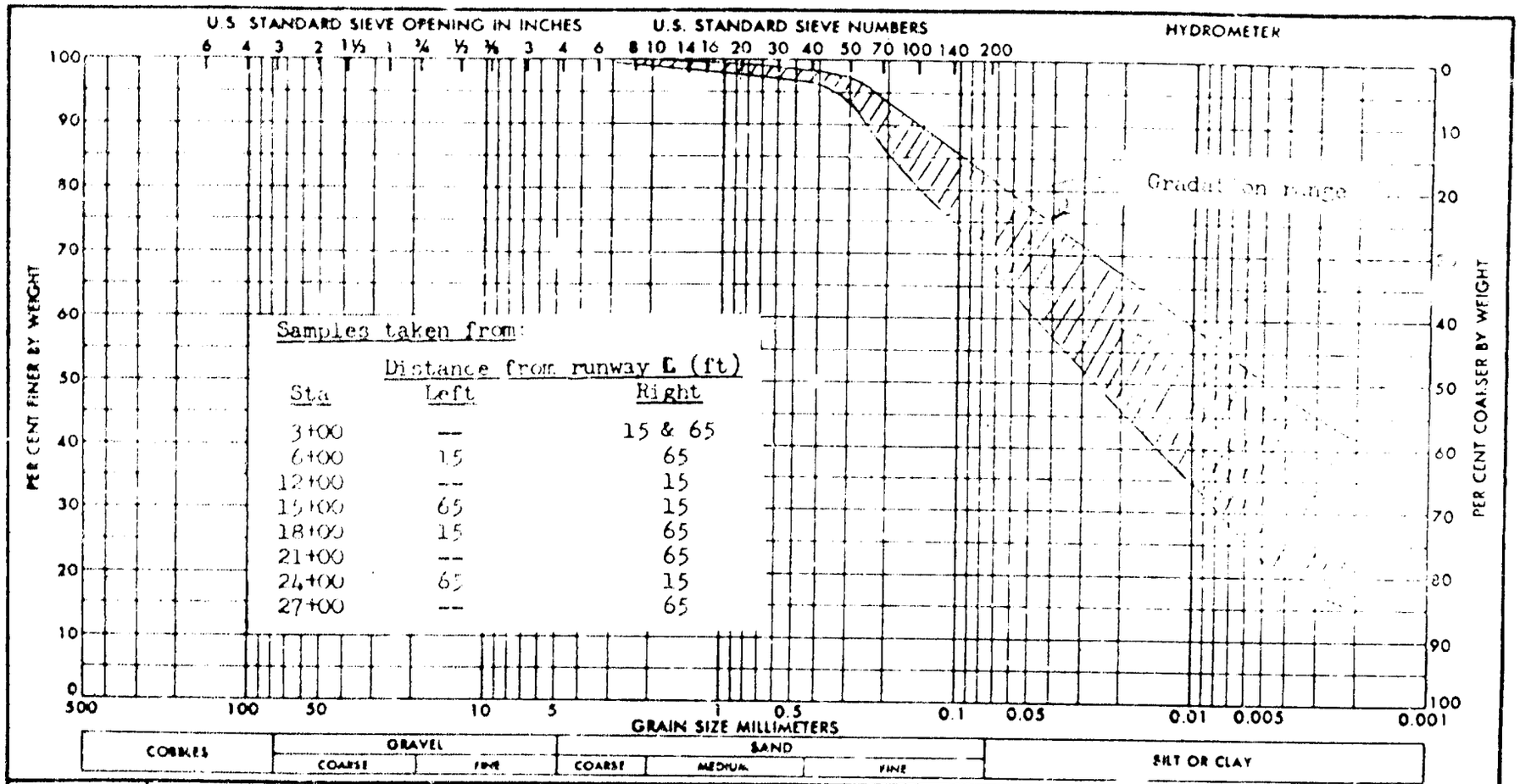
Station	Sample Location*	Sample from ½-in. to 3½-in. Depth: Water Content %	Sample from ½-in. to 3½-in. Depth: Dry Density lb/cu ft	Surface Water Content** %	Airfield Index at Depth (in.) of: 0	2	4	6	8	10	12
3+00	1	12.5	95.9	8.2	14	15+					
	2	10.8	102.3	5.3	15+						
	3	6.7	100.2	5.3	15+						
	4	5.8	98.4	6.1	12	15+					
6+00	1	12.9	94.9	8.9	15+						
	2	7.2	110.2	8.9	15+						
	3	7.5	110.5	6.2	15+						
	4	8.7	103.4	8.9	15+						
9+00	1	10.1	96.1	10.0	15+						
	2	5.2	110.3	9.6	15+						
	3	9.0	104.9	5.9	15+						
	4	12.2	97.9	6.8	15+	15+	12	12	12	12	11
12+00	1	10.8	95.5	8.5	15+						
	2	7.9	103.2	8.3	15+						
	3	8.6	100.6	5.5	15+						
	4	14.9	89.9	6.8	11	12	10	7	7	7	7
15+00	1	10.7	97.7	9.5	15+						
	2	6.2	106.3	5.8	15+						
	3	9.3	101.7	5.4	15+						
	4	10.9	94.1	6.3	10	11	12	13	13	14	15+

Station	Sample Location*	Sample from ½-in. to 3½-in. Depth: Water Content %	Sample from ½-in. to 3½-in. Depth: Dry Density lb/cu ft	Surface Water Content** %	Airfield Index at Depth (in.): 0	2	4	6	8	10	12
18+00	1	7.9	99.3	7.8	15+						
	2	7.4	103.0	6.5	15+						
	3	6.0	103.7	5.8	15+						
	4	8.0	88.7	5.9	9	14	15+				
21+00	1	7.5	100.3	11.2	15+						
	2	5.6	101.9	7.4	15+						
	3	7.2	95.7	5.1	15+						
	4	8.3	94.9	5.7	15+						
24+00	1	7.7	94.2	11.2	15+						
	2	6.3	102.4	7.4	15+						
	3	6.9	99.4	5.2	15+						
	4	8.2	93.5	6.1	15+	15+	15+	8	8	11	
27+00	1	5.9	106.2	7.7	15+						
	2	6.4	105.4	7.8	15+						
	3	5.8	108.1	5.4	15+						
	4	6.1	96.8	5.7	3	7	11	13	15+		

* Legend for sample location is as follows:

Sample Location No.	Distance and Position from Runway Center Line
1	65 ft left
2	15 ft left
3	15 ft right
4	65 ft right

** Surface water contents were taken from 0- to ½-in. depth immediately prior to dust-control treatment.



SAMPLE NO	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
				(Ranges)		
	0 to 5 in.	silty clay (CL) with sand		31-43	14-19	16-25
				(Averages)		
				37	17	20

GRADATION CURVES

PROJECT USAF: [illegible] 7-7-0888-01/02 (Inte-grated RT/AT of Dust-Contr[illegible] Materials)

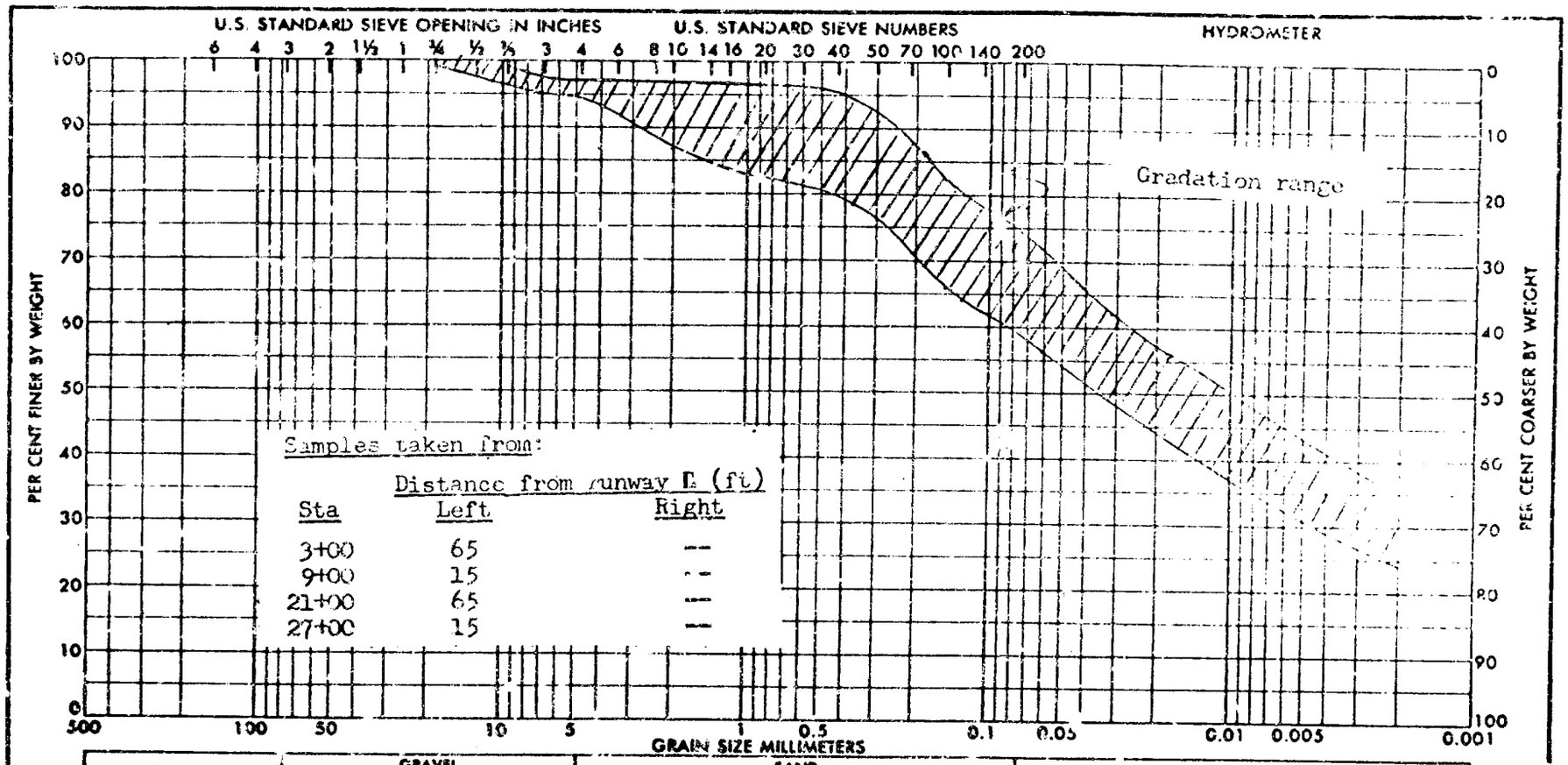
AREA Dyess AFB, Texas

BORING NO

DATE May-June 1967

ENG FORM 2087 1 MAY 63 REPLACES WES FORM NO 1241, SEP 1962, WHICH IS OBSOLETE

U.S. GOVERNMENT PRINTING OFFICE 1963 O—700-126



SAMPLE NO.	ELEV OR DEPTH	CLASSIFICATION	N...T W%	LL	PL	PI
	0 to 5 in.	sandy clay (CL) with grave		(Ranges)		
				36-41	14-19	18-22
				(Averages)		
				38	17	21

GRADATION CURVES

PROJECT USATECOM 7-7-0828-01/02 (Integrated ET/ST of Dust-Control Materials)

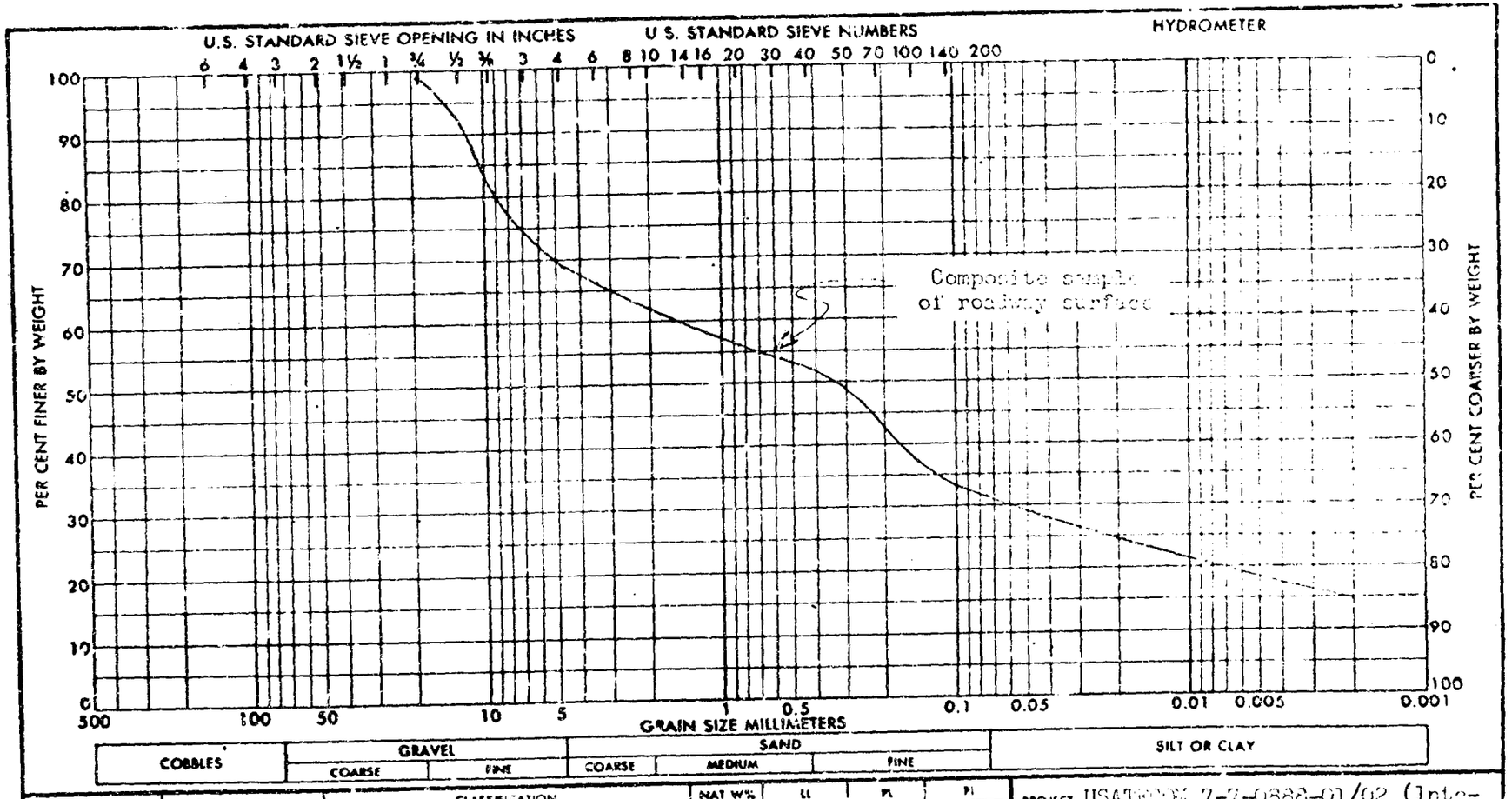
AREA Dyess AFB, Texas

BORING NO

DATE May–June 1967

ENG FORM 2087 1 MAY 63 REPLACES WES FORM NO. 1241, SEP 1962, WHICH IS OBSOLETE.

U.S. GOVERNMENT PRINTING OFFICE 1963 O—709-128



SAMPLE NO	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
	0 to 5 in.	clayey sand (SC) with gravel		24	10	14

GRADATION CURVES

PROJECT USATRECOM 7-7-0888-01/02 (Integrated M/MT of Dust-Control Material)

AREA Dyess AFB, Texas

BORING NO

DATE May-June 1967

U S GOVERNMENT PRINTING OFFICE : 1963 O—729-126

ENG FORM 2087
1 MAY 62

REPLACES WES FORM NO. 1241, SEP 1962, WHICH IS OBSOLETE.

USAE WATERWAYS EXPERIMENT STATION

RESULTS OF SOIL TESTS FOR USATECOM PROJECT NO. 7-7-0888-01/02 (INTEGRATED ENGINEERING AND SERVICE TESTS OF DUST-CONTROL MATERIALS)

FORT LEONARD WOOD, MISSOURI
JULY 1967

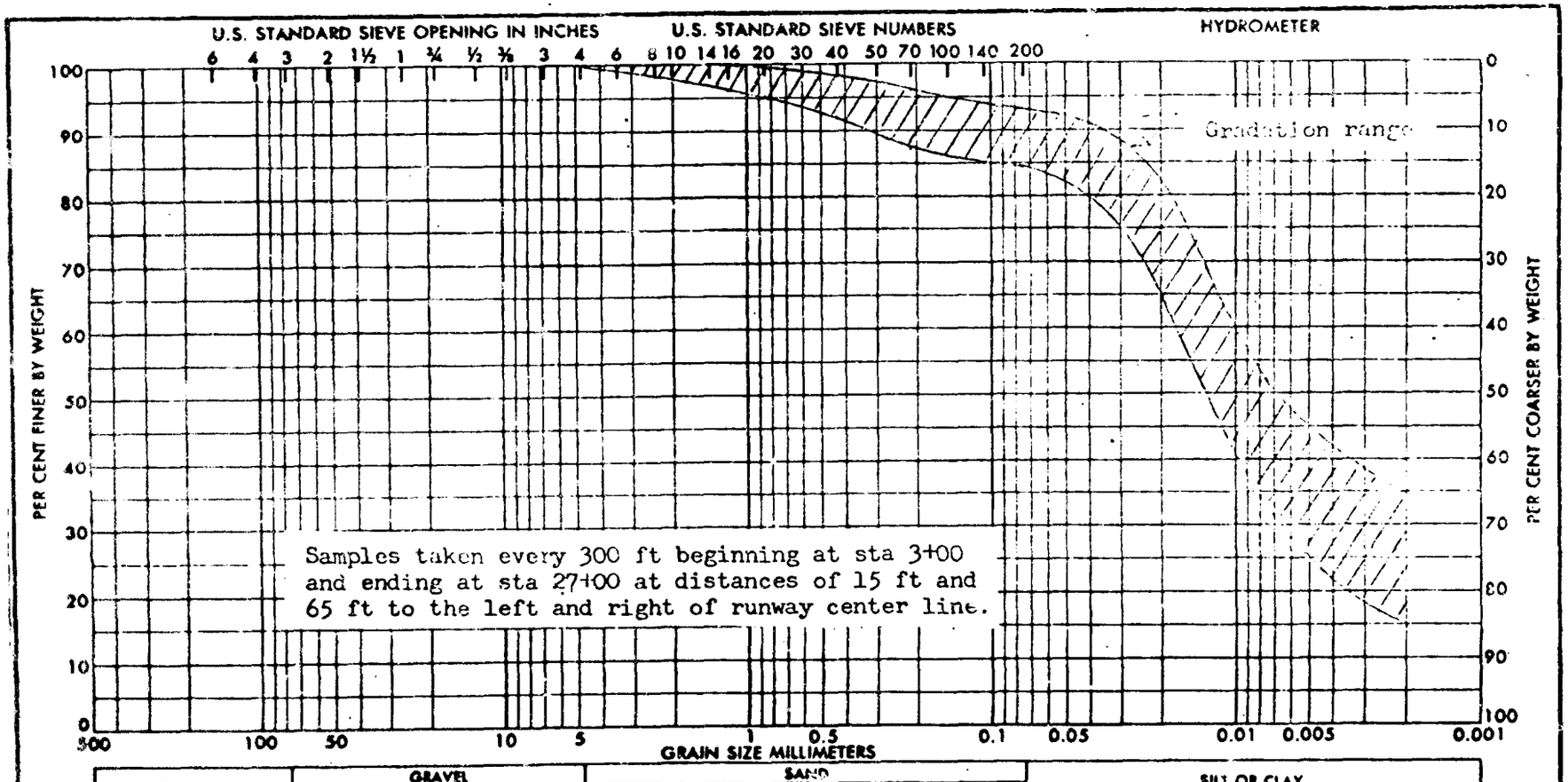
Station	Sample Location*	Sample from ½-in. to 3½-in. Depth: Water Content %	Sample from ½-in. to 3½-in. Depth: Dry Density lb/cu ft	Surface Water Content** %	Airfield Index at Depth (in.) of: 0	2	4	6	8	10	12	14	16
3+00	1	18.1	91.3	9.2	13	14	13	9	7	7	8	7	8
	2	16.7	97.0	7.8	14	15+	15	8	9	9	8	9	8
	3	16.8	91.1	12.1	15	15+	15+	10	9	10	10	9	9
	4	19.6	86.5	15.3	11	13	11	9	7	7	7	7	7
6+00	1	20.2	101.0	10.1	12	15+	7	7	7	7	8	8	8
	2	18.4	98.1	5.8	13	15+	8	8	8	7	6	7	7
	3	19.7	87.4	6.1	8	12	15+	10	9	7	8	7	8
	4	19.8	95.8	10.3	14	15+	12	9	8	8	9	11	12
9+00	1	17.5	95.3	13.2	11	15+	15+	8	8	7	7	8	8
	2	19.2	98.3	12.7	9	15+	11	9	10	8	7	15+	
	3	18.2	94.6	9.3	14	15+	15+	14	10	14	15+		
	4	16.3	95.8	13.1	14	15+	15+	15+					
12+00	1	21.0	91.1	13.7	12	10	8	7	6	6	6	9	9
	2	16.4	96.9	8.0	15	15+	12	12	10	9	8	10	11
	3	17.2	93.3	6.3	14	15+	15+	9	8	8	7	7	8
	4	20.9	90.0	15.0	11	15	14	11	8	7	7	6	7
15+00	1	19.3	93.5	13.0	15	15+	9	7	7	7	8	9	11
	2	18.1	100.0	9.4	15	15+	11	9	10	10	9	10	12
	3	15.6	92.6	8.1	14	15+	15+	11	10	10	8	8	9
	4	20.0	93.3	10.8	11	14	12	9	7	6	5	5	7

Station	Sample Location*	Sample from ½-in. to 3½-in. Depth: Water Content %	Sample from ½-in. to 3½-in. Depth: Dry Density lb/cu ft	Surface Water Content** %	Airfield Index at Depth (in.) of: 0	2	4	6	8	10	12	14	16
18+00	1	16.8	95.2	9.6	10	15+	8	6	6	5	6	6	6
	2	15.4	89.6	8.5	14	15+	15+	10	8	6	5	5	7
	3	18.1	89.1	7.5	13	15+	15+	10	8	7	7	7	7
	4	17.9	87.4	13.9	12	15+	15	12	8	8	8	7	7
21+00	1	16.7	96.8	10.4	10	15+	15+	8	8	9	9	10	12
	2	17.1	99.6	7.1	11	15+	15+	8	9	10	10	11	12
	3	19.4	96.8	9.4	14	15+	11	8	8	8	7	8	8
	4	14.3	91.0	12.6	14	15+	10	11	9	15+			
24+00	1	14.0	92.8	11.6	14	15+	14	7	7	8	8	6	5
	2	15.4	92.0	8.9	9	15+	15+						
	3	19.2	90.3	7.4	14	14	13	10	9	8	7	6	7
	4	14.0	91.9	14.0	14	15+	10	8	9	8	8	11	11
27+00	1	17.5	91.9	8.2	10	15+	15+	8	8	8	8	8	7
	2	18.6	91.2	12.0	5	15+	15+	15	7	6	7	8	8
	3	17.4	93.0	6.3	14	15+	15+	9	9	8	8	8	9
	4	20.6	90.2	13.2	11	14	13	8	7	7	7	6	7

* Legend for sample location is as follows:

Sample Location No.	Distance and Position from Runway Center Line
1	65 ft left
2	15 ft left
3	15 ft right
4	65 ft right

** Surface water contents were taken from 0- to ½-in. depth immediately prior to dust-control treatment.



SAMPLE NO	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
	0 to 5 in.	clayey silt (CL) with		(Ranges)		
		traces of sand and		28-42	15-23	8-21
		rootlets		(Averages)		
				34	20	14

GRADATION CURVES

PROJECT USATECOM 7-7-0888-01/02 (Integrated ET/ST of Dust-Control Materials)

AREA Fort Leonard Wood, Missouri

BORING NO.

DATE July 1967

ENG FORM 2087 1 MAY 62 REPLACES WES FORM NO. 1241, SEP 1962, WHICH IS OBSOLETE.

U.S. GOVERNMENT PRINTING OFFICE : 1963 O-700-126

EMPLACEMENT DATA (Runway)

SITE: Eglin AFB

MATERIAL	DATE PLACED 1967	AREA TREATED SQ YD	DILUTION RATIO* DESIRED By Vol	DESIRED By Wt	ACTUAL By Vol	ACTUAL By Wt	RATE OF APPLICATION** DESIRED Gal/Yd^2	ACTUAL Gal/Yd^2	QUANTITY OF BASIC MATERIAL USED Gal/Yd^2	Lb/Sq Yd
CODE A	19 Apr	2,417	2.00	2.30	2.16	2.37	0.40	0.36	0.25	2.31
CODE B	17 Apr	2,417	2.00	2.20	1.75	1.93	0.40	0.39	0.29	2.30
CODE C	20 Apr	2,750	2.00	2.10	1.88	1.99	0.40	0.39	0.29	2.25
CODE D	19 Apr	2,750	--	--	--	--	0.37	0.41	0.41	3.32
CODE E	19 Apr	2,750	--	--	--	--	0.35	0.40	0.40	3.45
CODE F	20 Apr	2,750	--	--	--	--	0.37	0.35	0.35	2.83

*Dilution expressed as ratio of quantity of basic material to quantity of water.
**Includes water of dilution for applicable materials.

EMPLACEMENT DATA (Shoulder)

SITE: Eglin AFB

MATERIAL	DATE PLACED 1967	AREA TREATED SQ YD	DILUTION RATIO* DESIRED By Vol	DESIRED By Wt	ACTUAL By Vol	ACTUAL By Wt	RATE OF APPLICATION** DESIRED Gal/Sq Yd	ACTUAL Gal/Sq Yd	QUANTITY OF BASIC MATERIAL USED Gal/Sq Yd	Lb/Sq Yd
CODE A	18 Apr	3,867	2.00	2.30	1.98	2.24	0.40	0.41	0.27	2.57
CODE B	17 Apr	3,544	2.00	2.20	1.75	1.93	0.40	0.41	0.25	2.41
CODE C	20 Apr	4,400	2.00	2.10	1.92	2.03	0.40	0.43	0.28	2.49
CODE D	19 Apr	3,667	--	--	--	--	0.37	0.40	0.40	3.20
CODE E	19 Apr	4,125	--	--	--	--	0.35	0.42	0.42	3.55
CODE F	20 Apr	4,400	--	--	--	--	0.37	0.38	0.38	3.07

*Dilution expressed as ratio of quantity of basic material to quantity of water.
**Includes water of dilution for applicable materials.

EMPLACEMENT DATA (Runway)

SITE: Fort Leonard Wood

MATERIAL	DATE PLACED 1967	AREA TREATED SQ YD	DILUTION RATIO* DESIRED By Vol	DESIRED By Wt	ACTUAL By Vol	ACTUAL By Wt	RATE OF APPLICATION** DESIRED Gal/Yd^2	ACTUAL Gal/Yd^2	QUANTITY OF BASIC MATERIAL USED Gal/Yd^2	lb/Yd^2
CODE A	9 Jul	3,520	2.00	2.20	2.08	2.35	0.33	0.33	0.23	2.12
CODE B	9 Jul	3,330	2.00	2.20	2.08	2.31	0.33	0.33	0.22	2.06
CODE C	8 Jul	2,860	2.00	2.10	2.11	2.19	0.37	0.39	0.26	2.29
CODE D	8 Jul	3,340	--	--	--	--	0.37	0.37	0.37	3.02
CODE E	10 Jul	3,330	--	--	--	--	0.35	0.35	0.35	3.02
CODE F	10 Jul	3,330	--	--	--	--	0.37	0.37	0.32	2.44

*Dilution expressed as ratio of quantity of basic material to quantity of water.
**Includes water of dilution for applicable materials.

EMPLACEMENT DATA (Shoulder)

SITE: Fort Leonard Wood

MATERIAL	DATE PLACED 1967	AREA TREATED YD^2	DILUTION RATIO* DESIRED By Vol	DESIRED By Wt	ACTUAL By Vol	ACTUAL By Wt	RATE OF APPLICATION** DESIRED Gal/Yd^2	ACTUAL Gal/Yd^2	QUANTITY OF BASIC MATERIAL USED Gal/Yd^2	Lb/Yd^2
CODE A	9 Jul	7,250	2.00	2.20	2.12	2.40	0.33	0.32	0.21	1.94
CODE B	9 Jul	7,340	2.00	2.20	1.58	1.74	0.33	0.35	0.21	1.93
CODE C	8 Jul	5,920	2.00	2.10	2.02	2.14	0.33	0.34	0.23	1.97
CODE D	8 Jul	7,770	--	--	--	--	0.37	0.37	0.37	2.95
CODE F	10 Jul	6,440	--	--	--	--	0.35	0.41	0.41	3.46
CODE F	10 Jul	7,220	--	--	--	--	0.37	0.38	0.38	3.04

*Dilution expressed as ratio of quantity of basic material to quantity of water.
**Includes water of dilution for applicable materials.

EMPLACEMENT DATA (Runway)

SITE: Dyess AFB

MATERIAL	DATE PLACED 1967	AREA TREATED Yd^2	DILUTION RATIO* DESIRED By Vol	DESIRED By Wt	ACTUAL By Vol	ACTUAL By Wt	RATE OF APPLICATION** DESIRED Gal/Yd^2	ACTUAL Gal/Yd^2	QUANTITY OF BASIC MATERIAL USED Gal/Yd^2	Lb/Yd^2
CODE A	2 Jun	3,170	2.00	2.20	1.98	2.24	0.33	0.32	0.22	2.07
CODE B	4 Jun	3,170	2.00	2.20	2.15	2.32	0.33	0.32	0.22	1.98
CODE C	3 Jun	3,170	2.00	2.10	2.13	2.23	0.33	0.33	0.22	1.93
CODE D	4 Jun	3,170	--	--	--	--	0.37	0.37	0.37	2.94
CODE E	2 Jun	3,170	--	--	--	--	0.35	0.35	0.35	3.00
CODE F	4 Jun	3,170	--	--	--	--	0.37	0.39	0.39	3.13

*Dilution expressed as ratio of quantity of basic material to quantity of water.
**Includes water of dilution for applicable materials.

EMPLACEMENT DATA (Shoulder)

SITE: Dyess AFB

MATERIAL	DATE PLACED 1967	AREA TREATED Yd^2	DILUTION RATIO* DESIRED By Vol	DESIRED By Wt	ACTUAL By Vol	ACTUAL By Wt	RATE OF APPLICATION** DESIRED Gal/Yd^2	ACTUAL Gal/Yd^2	QUANTITY OF BASIC MATERIAL USED Gal/Yd^2	Lb/Yd^2
CODE A	2 Jun	7,170	2.00	2.20	1.95	2.22	0.33	0.35	0.23	2.16
CODE B	4 Jun	7,350	2.00	2.20	2.31	2.50	0.33	0.33	0.26	2.29
CODE C	3 Jun	6,900	2.00	2.10	2.24	2.37	0.33	0.36	0.25	2.21
CODE D	3 Jun	6,690	--	--	--	--	0.37	0.36	0.36	2.94
CODE E	4 Jun	7,260	--	--	--	--	0.35	0.37	0.37	3.10
CODE F	4 Jun	7,000	--	--	--	--	0.37	0.40	0.40	3.28

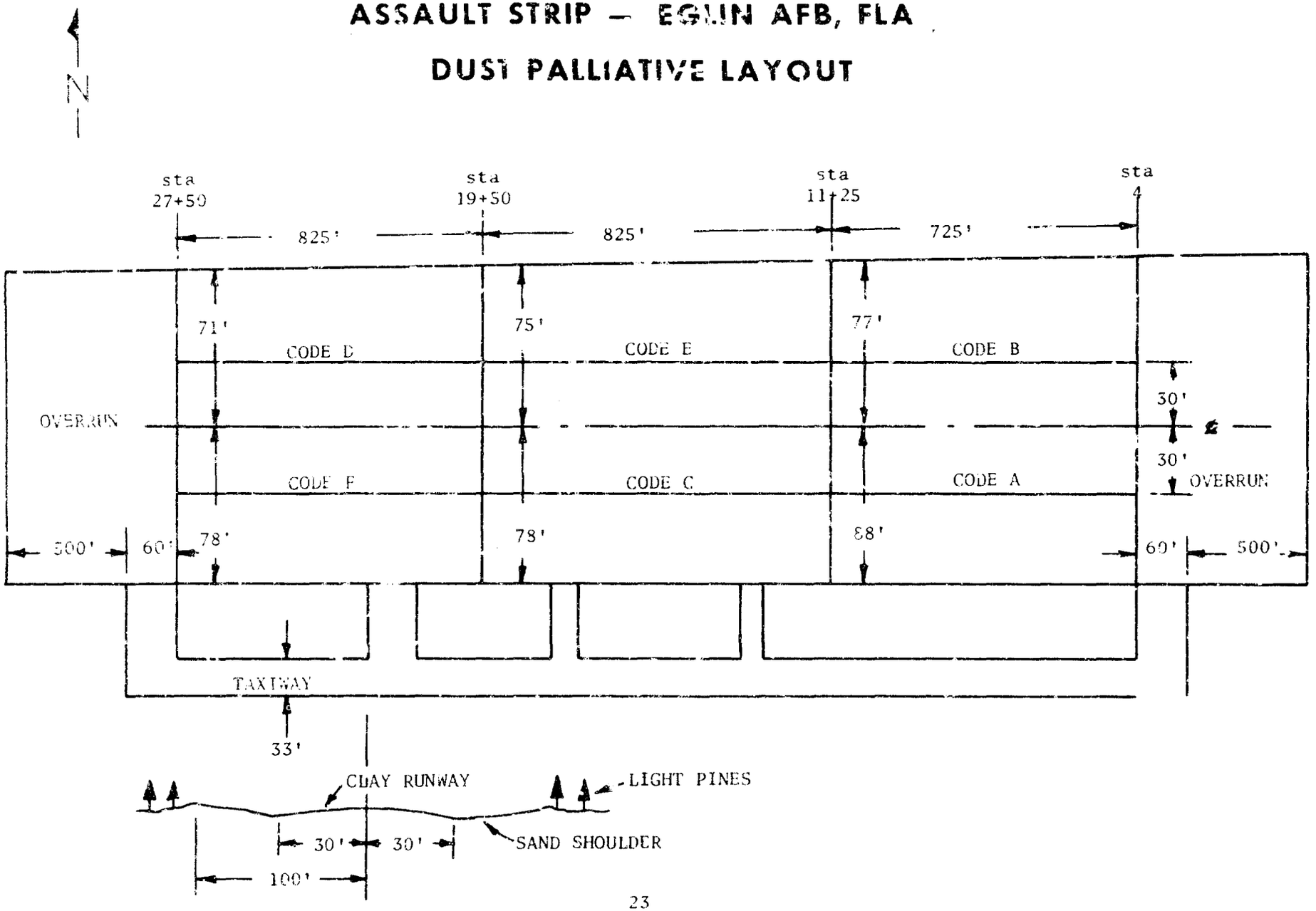
*Dilution expressed as ratio of quantity of basic material to quantity of water.
**Includes water of dilution for applicable materials.

PENETRATIONS

SITE	MATERIAL	RUNWAY		SHOULDER	
		FILM (inches)	PENETRATION (inches)	FILM (inches)	PENETRATION (inches)
Eglin AFB	CODE A	1/32	1/16-1/4	1/32-1/16	3/32-5/16
	CODE B	1/32	1/8-3/16	1/32-1/16	1/8-5/16
	CODE C	1/32	1/16-3/16	1/32-1/16	*Lt Green 1/2-3/4 *Drk Green 1/4-1/2
	CODE D	--	1/16-1/8	--	1/2-3/4
	CODE E	--	1/16	--	1/4-3/4
	CODE F	--	1/32-1/16	--	1/2-3/4
Dyess AFB	CODE A	1/32	1/8	1/32	1/8
	CODE B	1/32-1/16	1/8-1/32	1/32-1/16	1/8-1/32
	CODE C	1/32	1/32	1/32-1/16	1/8-1/32
	CODE D	--	5/16-9/16	--	7/16-11/16
	CODE E	--	5/16-9/16	--	7/16-5/8
	CODE F	--	5/16-9/16	--	1/2-13/16
Fort Leonard Wood	CODE A	1/32	1/32	1/32	1/32-1/16
	CODE B	1/32	1/32-1/16	1/32	1/32-1/8
	CODE C	1/32	1/32	1/32	1/32-1/16
	CODE D	--	1/4-1/2	--	3/16-3/4
	CODE E	--	1/8-9/16	--	1/8-7/16
	CODE F	--	1/16-1/4	--	1/4-7/16

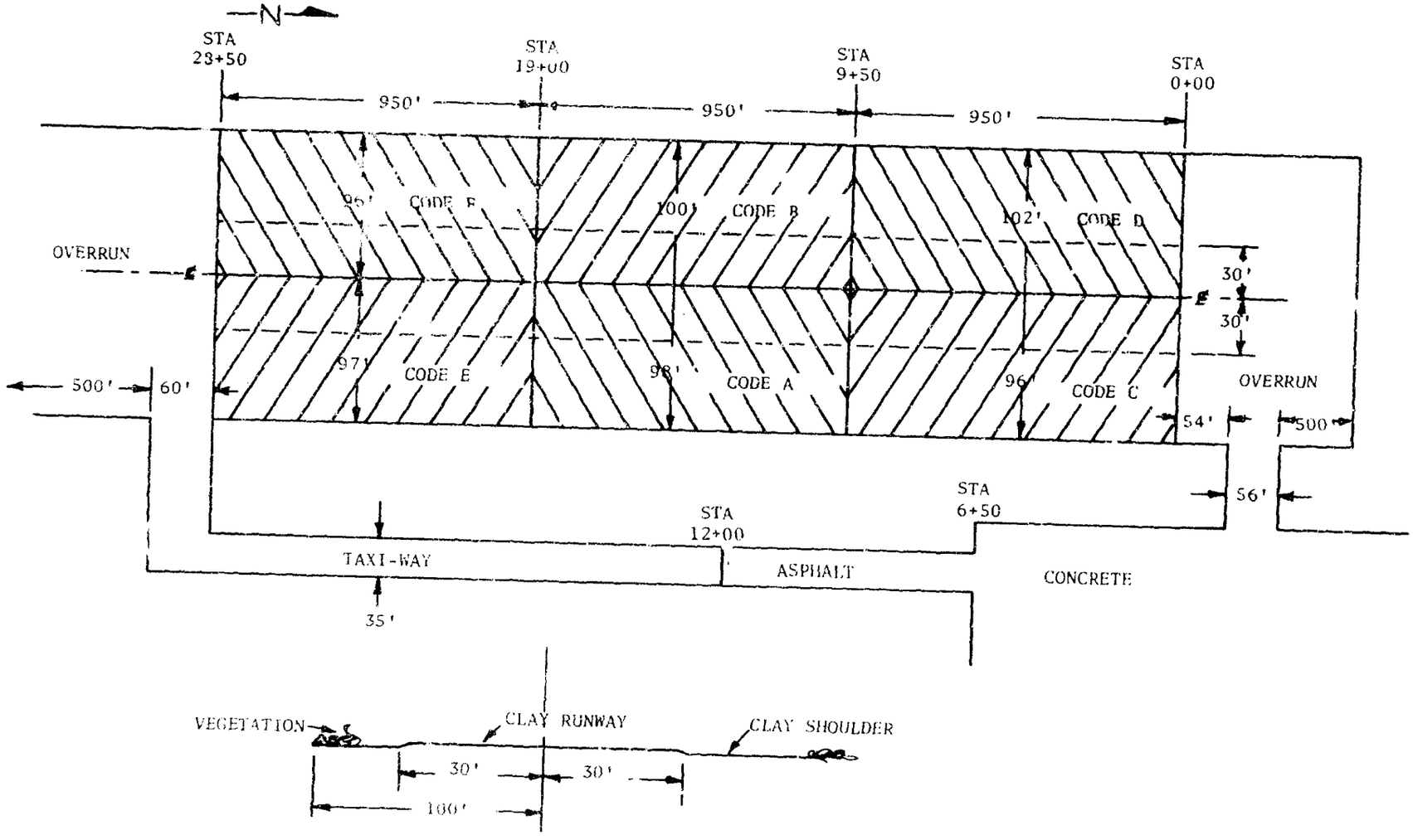
ASSAULT STRIP — EGLIN AFB, FLA

DUST PALLIATIVE LAYOUT



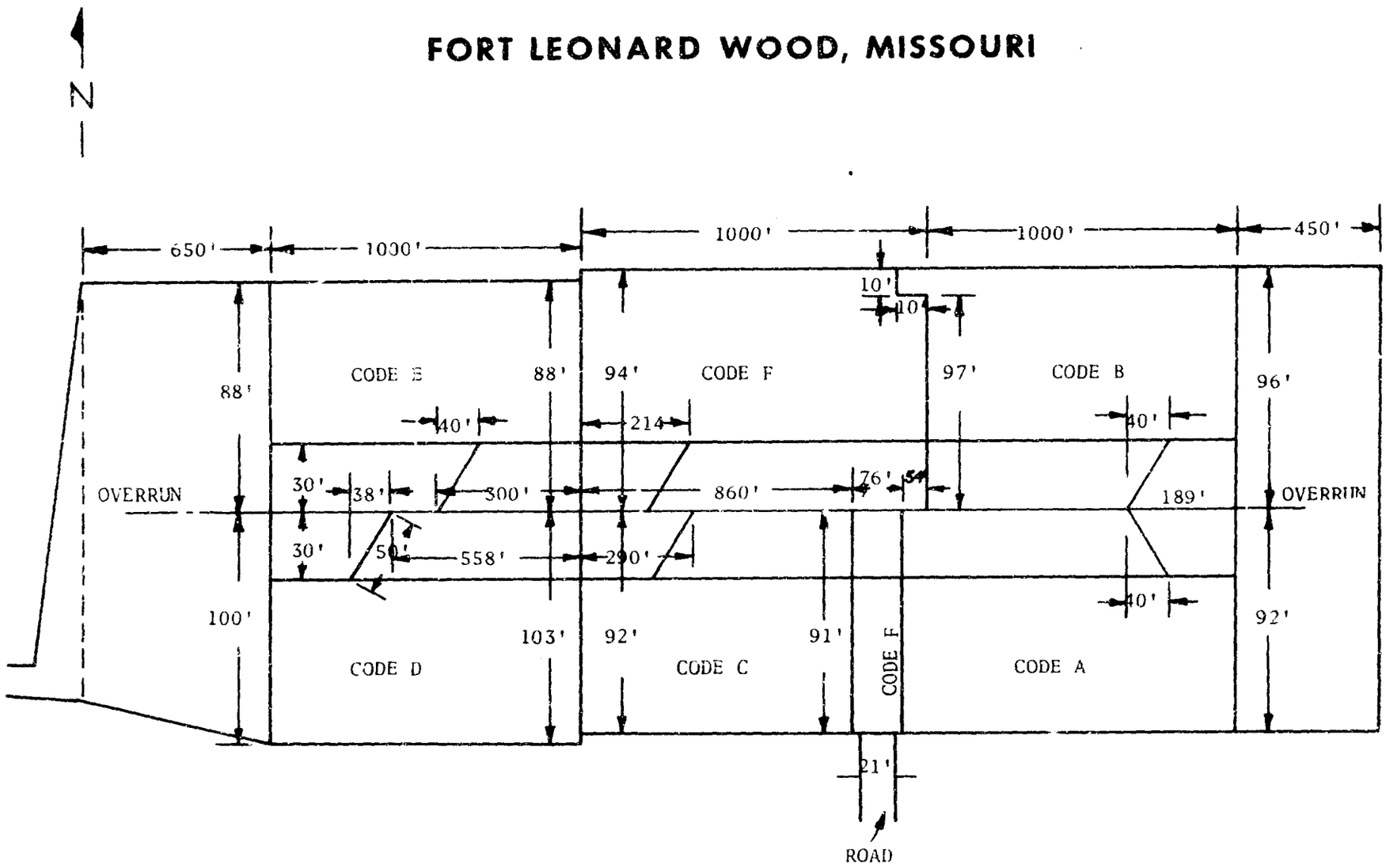
ASSAULT STRIP – DYESS AFB, TEXAS

DUST PALLIATIVE LAYOUT



AIR FIELD #1

FORT LEONARD WOOD, MISSOURI



EFFORT AND EQUIPMENT HOURS REQUIRED IN A LOADING/EMPLACING TEST MATERIAL CYCLE

AN EMULSION-TYPE MATERIAL (I.E , CODE B)

Operation No and Task	Type Equipment Used	Man-hours	Men	Equipment-hours
1. Open 12 drums (See page 5, inclosure 2.)	1 Bolt Cutter 1 pair Pliers 1 Screwdriver 1 Wrench	0.267	2	--
2. Position drums	--	0.666	2	--
3. Load distributor (See page 6, inclosure 2.)	1 Distributor, Asphalt	1 250	5	0.250
	1 Distributor, Water	0.300	2	0.130
4. Circulate distributor	1 Distributor, Asphalt	0.084	2	0.084
5. Prewetting (See page 7, inclosure 2.)	1 Distributor, Water	0.100	2	0.050
6 Placement of material (See page 8, inclosure 2.)	1 Distributor, Asphalt	0.300	3	0.100
7. Measure residue	1 Distributor, Asphalt	0 020	1	0.020
	1 Measuring Rod			
8. Placed on road	1 Distributor, Asphalt	0.100	3	0.100
	1 Distributor, Water	0 100	2	0.050
9. Travel and maneuver	1 Distributor, Asphalt	0.250	2	0 250

AN ASPHALT-TYPE MATERIAL (I.E., CODE E) TAKEN FROM 55-GALLON DRUMS

Operation No and Task	Type Equipment Used	Man-hours	Men	Equipment-hours
1. Open 18 drums	1 pair pliers 1 Screwdriver 1 Wrench	0.025	2	--
2. Position drums	--	0.666	2	--
3. Load distributor (See page 9, inclosure 2.)	1 Distributor, Asphalt	0.865	5	0.217
4. Circulate and heat	1 Distributor, Asphalt	0.500	2	0.250
5. Prewetting (See page 7, inclosure 2.)	1 Distributor, Water	0.100	2	0.050
6. Placement of material (See page 8, inclosure 2.)	1 Distributor, Asphalt	0.270	3	0.100
7. Measure residue	1 Distributor, Asphalt	0.020	1	0.020
	1 Measuring rod			
8. Place on road	1 Distributor, Asphalt	0.100	3	0.100
	1 Distributor, Water	0.100	2	0.250
9. Travel and maneuver	1 Distributor, Asphalt	0.250	2	0.250

AN ASPHALT-TYPE MATERIAL (I.E., CODE F), TAKEN FROM A TANKER TRUCK

Operation No and Task	Type Equipment Used	Man-hours	Men	Equipment-hours
1. Load distributor (See page 10, inclosure 2.)	1 Distributor, Asphalt	0 166	5	0.083
	1 Tanker Truck			
2. Circulate and heat (if necessary)	1 Distributor, Asphalt	0 500	2	0 250
3. Prewetting (See page 7, inclosure 2.)	1 Distributor, Water	0.100	2	0.050
4. Placement of material (See page 8, inclosure 2.)	1 Distributor, Asphalt	0.270	3	0.100
5. Measure residue	1 Distributor, Asphalt	0.020	1	0.020
	1 Measuring Rod			
6. Placed on road	1 Distributor, Asphalt	0.100	3	0.100
	1 Distributor, Water	0.100	2	0 100
7. Travel and maneuver	1 Distributor, Asphalt	0 250	2	0 250

TIME AND MANPOWER UTILIZATION

SITE	MATERIAL	TIME RATE OF PLACEMENT SQ YD/HR	MANPOWER UTILIZATION MAN-HOURS	MANPOWER UTILIZATION YD^2/MAN-HOURS
Eglin AFB	CODE A	1,866	33.8	186
	CODE B	1,790	33.3	179
	CODE C	3,180	22.5	318
	CODE D	2,120	18.2	353
	CODE E	2,160	31.8	216
	CODE F	4,520	9.5	754
Dyess AFB	CODE A	4,130	25.1	413
	CODE B	5,810	18.2	582
	CODE C	4,940	20.5	546
	CODE D	7,220	7.5	1,440
	CODE E	4,090	12.5	820
	CODE F	8,850	5.8	1,770
Fort Leonard Wood	CODE A	4,350	24.7	436
	CODE B	4,420	24.2	442
	CODE C	3,550	24.7	355
	CODE D	7,400	7.5	1,480
	CODE E	6,500	7.5	1,309
	CODE F	2,120	10.8	1,020

MATERIAL PERFORMANCE RECORD

SITE	MATERIAL	SHOULDER DAMAGE		RUNWAY DAMAGE	
		CH-47A Rotor Wash	C-130E Prop Wash	CH-47A Rotor Wash	C-130E Prop Wash
Eglin AFB	CODE A	None	Slight	Moderate	Severe
	CODE B	Severe	Severe	Severe	Severe
	CODE C	Severe	Severe Slight*	Severe	Severe
	CODE D	Moderate	Moderate	Moderate	Moderate
	CODE E	Moderate	Moderate	Moderate	Moderate
	CODE F	None	Slight to Moderate	Slight	Moderate
Dyess AFB	CODE A	--	None	--	Slight
	CODE B	--	Severe	--	Severe
	CODE C	--	Severe	--	Severe
	CODE D	--	Moderate	--	Moderate
	CODE E	--	Moderate	--	Moderate
	CODE F	--	Slight	--	Slight
Fort Leonard Wood	CODE A	Slight to Moderate	Severe	Moderate	Severe
	CODE B	Moderate	Moderate	Severe	Severe
	CODE C	Moderate	Severe	Severe	Severe
	CODE D	Moderate	Slight to Moderate	Moderate	Slight to Moderate
	CODE E	Moderate	Moderate	Slight	Moderate
	CODE F	Slight	Slight	Slight	Moderate

*On light green section

DAMAGES INCURRED

C-130E AIRCRAFT

SITE	MATERIAL	DATE 1967	AREA TESTED yd^2	AREA DAMAGED yd^2	PERCENT OF TESTED AREA DAMAGED %
1. Eglin AFB	CODE A	10 May	850	3	0.40
	CODE B	10 May	712	16	2.50
	CODE C (Lt)	11 May	850	3	0.60
	CODE C (Drk)	11 May	850	19	2.50
	CODE D	11 May	600	8	1.30
	CODE E	10 May	660	3	0.30
	CODE F	11 May	850	13	1.50
2. Dyess AFB	CODE A	7 June	1,000	0	0.00
	CODE B	8 June	1,300	41	3.00
	CODE C	7 June	1,000	2	0.20
	CODE D	8 June	1,000	2	0.20
	CODE E	7 June	1,200	12	1.00
	CODE F	8 June	1,000	1	0.10
3. Fort Leonard Wood	CODE A	12 July	1,560	78	5.00
	CODE B	12 July	1,450	50	3.50
	CODE C	12 July	1,450	58	4.00
	CODE D	12 July	1,480	1.33	0.09
	CODE E	12 July	1,600	16	1.00
	CODE F	12 July	1,450	1	0.05

DAMAGES INCURRED

CH-47A HELICOPTER

SITE	MATERIAL	DATE 1967	AREA TESTED yd^2	AREA DAMAGED yd^2	PERCENT OF TESTED AREA DAMAGED %
1. Eglin AFB	CODE A	25 Apr	1,250	0	0.00
	CODE B	25 Apr	1,250	150	2.00
	CODE C	27 Apr	1,250	375	3.00
	CODE D	1 May	1,250	0	0.00
	CODE E	27 Apr	1,250	5	0.40
	CODE F	1 May	1,250	0	0.00
2. Dyess AFB	No tests				
3. Fort Leonard Wood	***CODE A	18 Jul	2,300	184	8.00
	*CODE B	18 Jul	900	9	1.00
	**CODE C	18 Jul	1,000	15	1.50
	CODE D	18 Jul	900	9	1.00
	CODE E	18 Jul	1,200	6	0.50
	CODE F	18 Jul	1,430	1	0.07

*Runway 840 yd^2 - 23% } Combination wheel
**Runway 236 yd^2 - 40% } and prop damage
***Most of this damaged area was material which had billowed but not ruptured.

EFFORT AND EQUIPMENT HOURS REQUIRED IN A
LOADING/PATCHING TEST MATERIAL CYCLE

EGLIN AFB, USING A COMPRESSOR AND A SPRAYING UNIT OPERATING DIRECTLY FROM A 10-GALLON MIXING CONTAINER

Operation No and Task	Type Equipment Used	Man-hours (4 men used)	Men	Equipment-hours
1. Loading equipment on truck (See page 4, inclosure 2.)	1 Code G Spray System 1 1/2-Ton truck	0.40	4	--
2. Loading mixer	1 Code G Spray System	0.20	2	--
3. Emplace (See page 11, inclosure 2.)	1 Code G Spray System	0.83	5	0.166
	TOTAL MAN-HOURS/CYCLE	1.43		

FORT LEONARD WOOD, USING A COMPRESSOR AND A SPRAYING UNIT OPERATING DIRECTLY FROM A 55-GALLON DRUM

Operation No and Task	Type Equipment Used	Man-hours (4 men used)	Men	Equipment-hours
1. Loading truck	1 Compressor and spraying unit 1 1/2-Ton truck	0.40	4	--
2. Emplace (See page 12, inclosure 2.)	1 Compressor and spraying unit	2.50	5	0.30
	TOTAL MAN-HOURS/CYCLE	2.90		

WEATHER DATA* (1967)

SITE	APRIL	MAY	JUNE	JULY	AUGUST
Eglin AFB	0.57 75-86	4.01 71-90	5.62 64-94	2.05 77-90	2.90 47-92
Dyess AFB	- -	1.97 55-102	3.92 60-102	- -	- -
Fort Leonard Wood	- -	- -	5.87 49-88	2.69 49-92	0.90 47-92

*Top Line: Total rainfall for month (inches). Bottom Line: Range of temperatures for month (°F)

EFFORT REQUIRED IN CLEANING OPERATION FOLLOWING EMPLACEMENT OF AN EMULSION-TYPE MATERIAL

	Operation No and Task	Type Materials Used	Man-hours	Men
1	Load distributor (See page 13, inclosure 2)	Water (900 gal) Laundry detergent (8 boxes)	0 83	5
2	Flush distributor (See page 14, inclosure 2)		0 25	3
3.	Load distributor (See page 13, inclosure 2)	Water (900 gal) Laundry detergent (4 boxes)	0 83	5
4	Flush distributor (See page 14, inclosure 2.)		0 25	3
5	Scrub valves on spray bar	1 wire brush	0.25	1
6	Scrub distributor filter	1 wire brush	0 16	1
		TOTAL	2 57	

EFFORT REQUIRED IN MAINTENANCE OPERATION WHEN SPRAYING APPARATUS IS CLOGGED WITH AN EMULSION MATERIAL.

	Operation No and Task	Type Materials Used	Man-hours	Men
1.	Clear valves on spray bar	1 screwdriver 1 wire brush	0.83	1
2.	Free the linkage on spray bar (See page 15, inclosure 2.)	1 can penetrating oil	0.33	2
		TOTAL	1.16	

USAE WATERWAYS EXPERIMENT STATION

LABORATORY ANALYSIS REPORT

Material: CODE D
Source: Lamar Refining Company; Lumberton, Mississippi
Used for: USATECOM Project No. 7-7-0888-01/02
(Integrated Engineering and Service Tests of Dust-Control Materials)
Location: Eglin AFB, Florida
Sampled by: USAE Waterways Experiment Station
Date Sampled: 19 April 1967

ANALYSIS

Characteristic	ASTM Test Method	Specification Min.	Specification Max.	Result
Kinematic Viscosity @ 140°F; cs	D 2170	70	140	138.2
Flash Point; C.O.P.; °F	D 92	150		215
Distillation:				
Total Distillate to 680°F; % by volume	D 402	10	30	16.4
Float Test on Distillation Residue @ 122°F; sec	D 139	20	100	40.5
Asphalt Residue:				
Residue of 100 Penetration; %	D 243	50		64.8
Ductility of 100 Penetration Residue @ 77°F; cm	D 113	100		82 (86 on repeat test)*
Solubility in Carbon Tetrachloride; %	D 2042	99.5		99.96
Water; %	D 95		0.5	0.13

* Alternate test also run with following results:

Ductility of 100 Penetration Residue @ 60°F; cm	100	23

USAE WATERWAYS EXPERIMENT STATION

LABORATORY ANALYSIS REPORT

Material: CODE F
Source: Okaloosa Paving Company; Shalimar, Florida
Used for: USATECOM Project No. 7-7-0888-01/02
(Integrated Engineering and Service Tests of Dust-Control Materials)
Location: Eglin AFB, Florida
Sampled by: USAE Waterways Experiment Station
Date Sampled: 20 April 1967

ANALYSIS

Characteristic	ASTM Test Method	Specification Min.	Specification Max.	Results
Flash Point, T.O.C., °F	D 1310	80		155
Saybolt Furol Viscosity @ 122°F, SSF	D 88	50	80	108
Kinematic Viscosity @ 140°F, cs	D 2170	65	100	122.5
Distillation to 680°F	D 402			
Residue Volume % by Difference		48		62
Residue Penetration @ 77°F, 100 g, 5 sec	D 5		18	32
Residue Ductility @ 77°F, 5 cm/min	D 113	3		150+
Residue Softening Point (Ring and Ball)	D 36		(See Note 1)	135°F
Residue Thin-Film Oven Test Penetration @ 77°F, 100 g, 5 sec	D 1754	3		9
Distillation to 500°F	D 402			
Residue Saybolt Furol Viscosity @ 210°F; SSF	D 88	95	300	350.1
Distillation to 600°F	D 402			
Residue Penetration @ 77°F, 100 g, 5 sec	D 5	50	90	76

Note 1: Maximum softening point shall be as follows:

When Residue Penetration (on Distillation to 680°F) Is:	Maximum Softening Point (Ring and Ball) Shall Be:
Less than 7	180°F
7 to 12	165°F
12 to 18	155°F

LABORATORY ANALYSIS REPORT

CODE D

[illegible], Texas

[illegible] Engineering and [illegible] (Dust Control Materials)

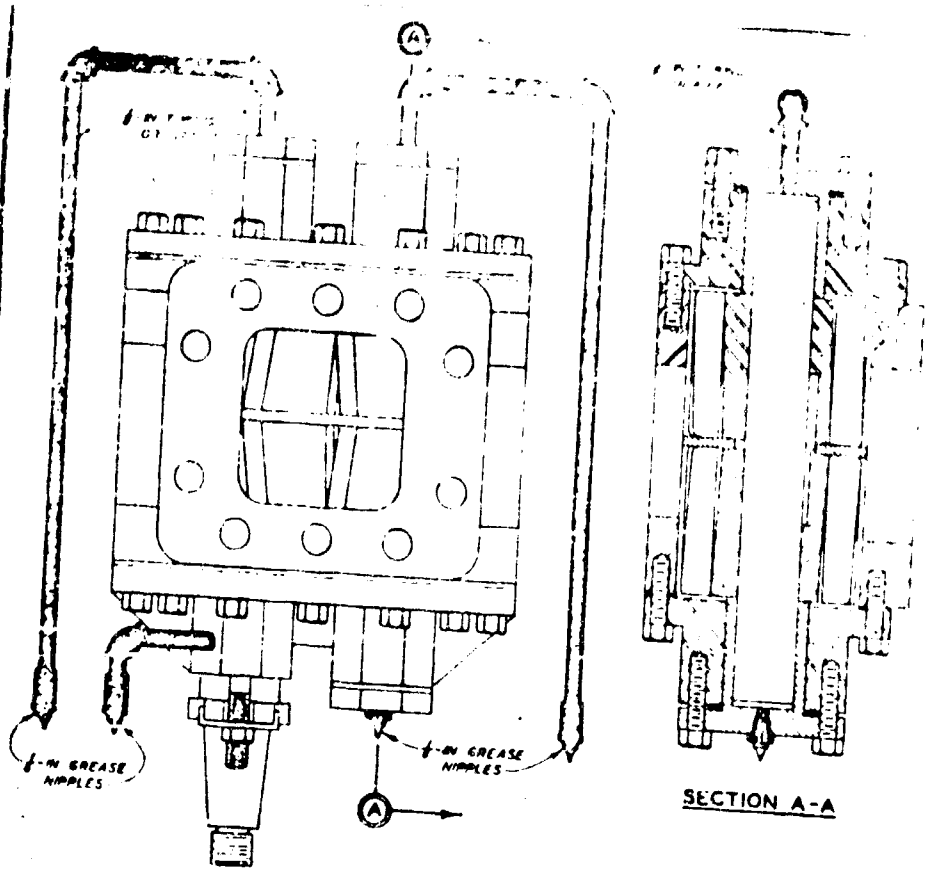
[illegible], Texas

[illegible]: USAE Waterways Experiment Station

Date sampled: 3 June 1967

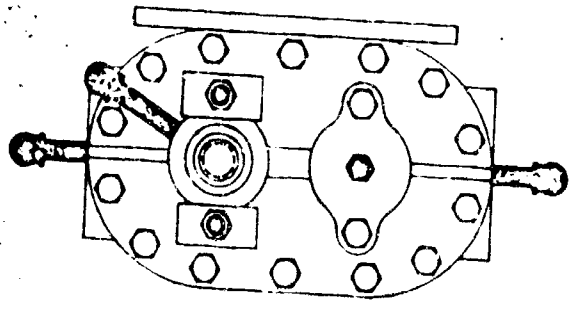
ANALYSIS

Characteristic	ASTM Test Method	Specification Min.	Specification Max.	Result
Kinematic Viscosity @ 140°F; cs	D 2170	70	140	143.3
Flash Point; C.O.P.; °F	D 92	150		240
Distillation:				
Total Distillate to 680°F; % by volume	D 402	10	30	26.5
Float Test on Distillation Residue @ 122°F; sec	D 139	20	100	112
Asphalt Residue:				
Residue of 100 Penetration; %	D 243	50		70.6
Ductility of 100 Penetration Residue @ 77°F; cm	D 113	100		150+
Solubility in Carbon Tetrachloride; %	D 2042	99.5		99.9
Water; %	D 95		0.5	0



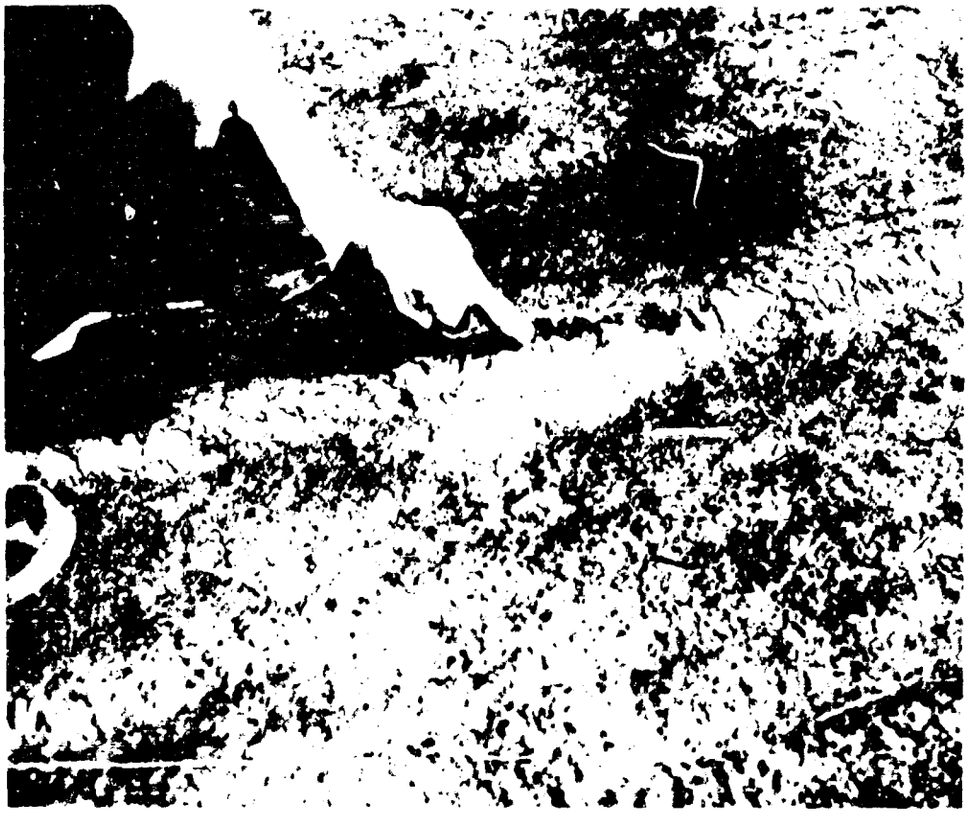
PLAN

SECTION A-A



FRONT VIEW

TYPICAL MODIFICATION REQUIREMENTS FOR CONVENTIONAL ASPHALT DISTRIBUTOR

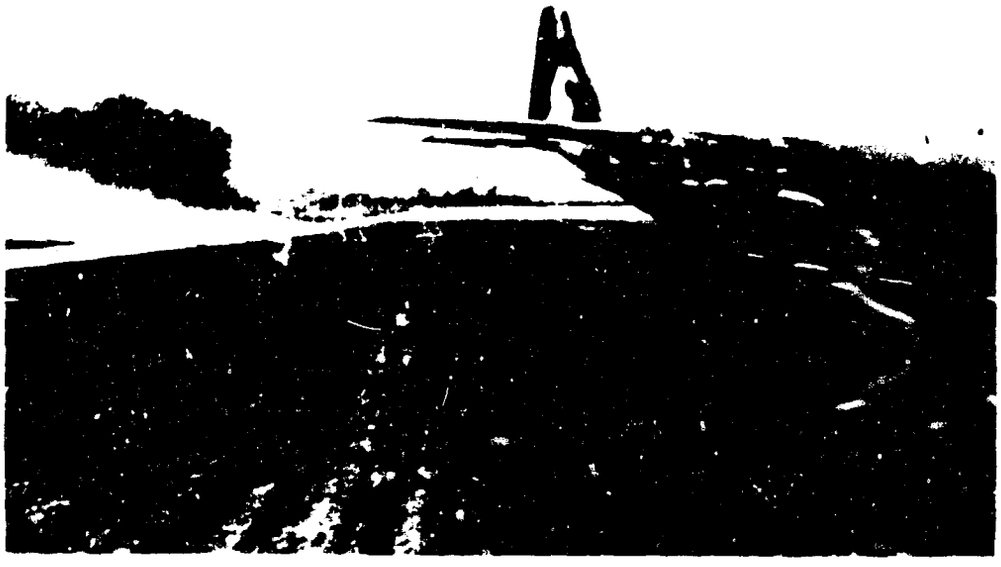


US ARMY ARMOR AND ENGINEER BOARD FORT KNOX, KY	USATECOM PROJ NO 7-7-0888-01/02 PHOTO NO 67-717

DUST CONTROL MATERIALS

WEAK AREAS IN FILM FORMER CAUSED
BY SURFACE IRREGULARITIES

Incl 2

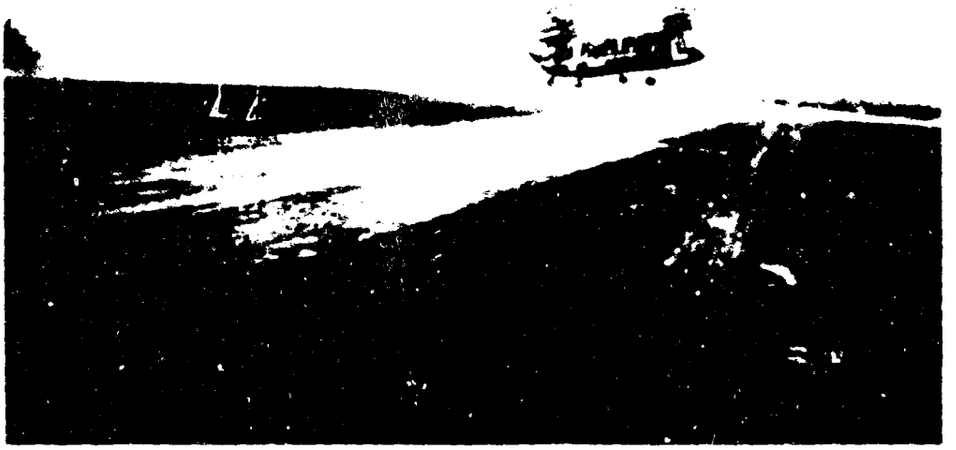


US ARMY ARMOR AND ENGINEER BOARD
FORT KNOX, KY

USATECOM PROJ NO 7-7-0888-01/02
PHOTO NO 67-1184M

DUST CONTROL MATERIALS

TESTING WITH A C-130E AIRCRAFT



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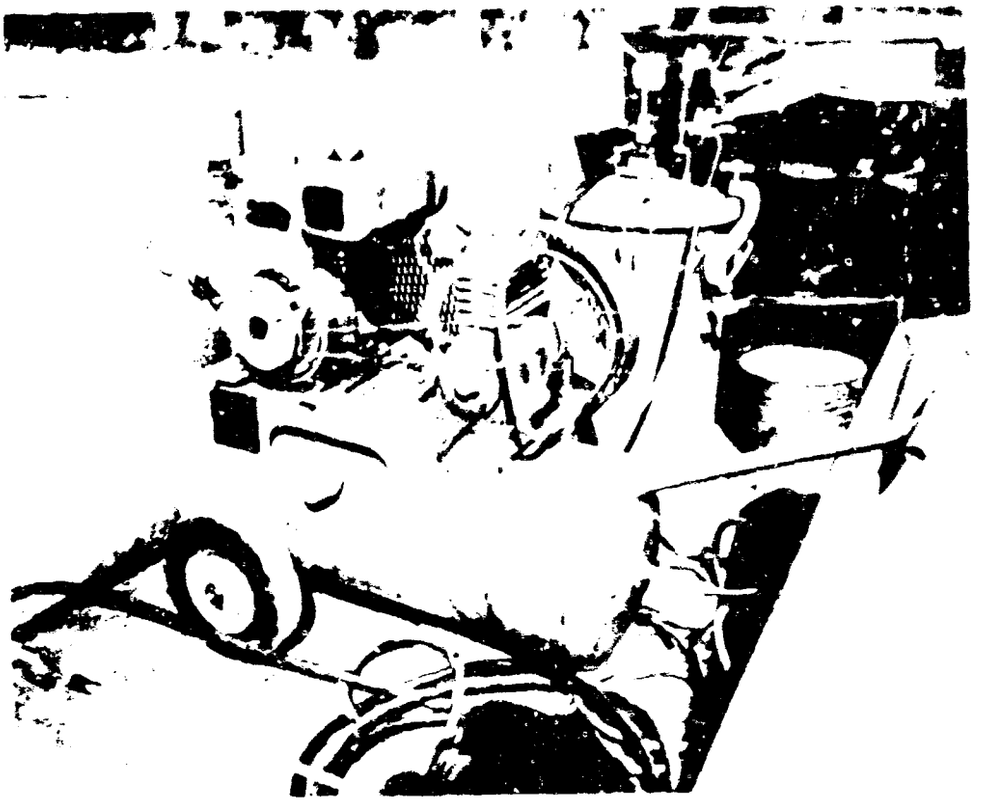
DUST CONTROL MATERIALS

TESTING WITH A CH-47A HELICOPTER



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DUST CONTROL MATERIALS

CODE G SPRAYING SYSTEM (LOADED ON TRUCK)
USED IN PATCHING OPERATIONS

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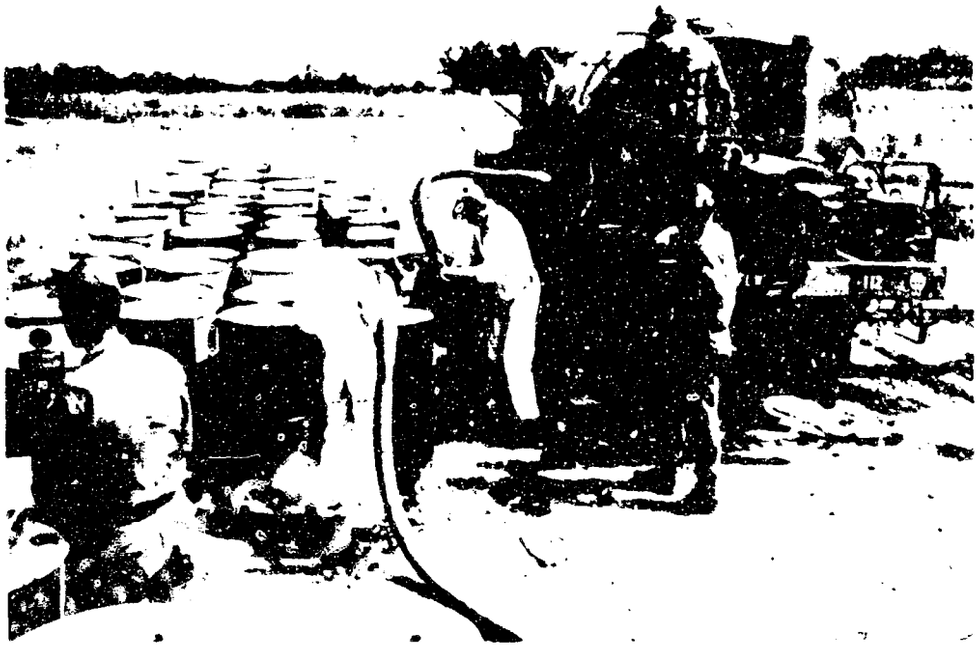
DUST CONTROL MATERIALS

OPENING THE OPEN TOP DRUMS



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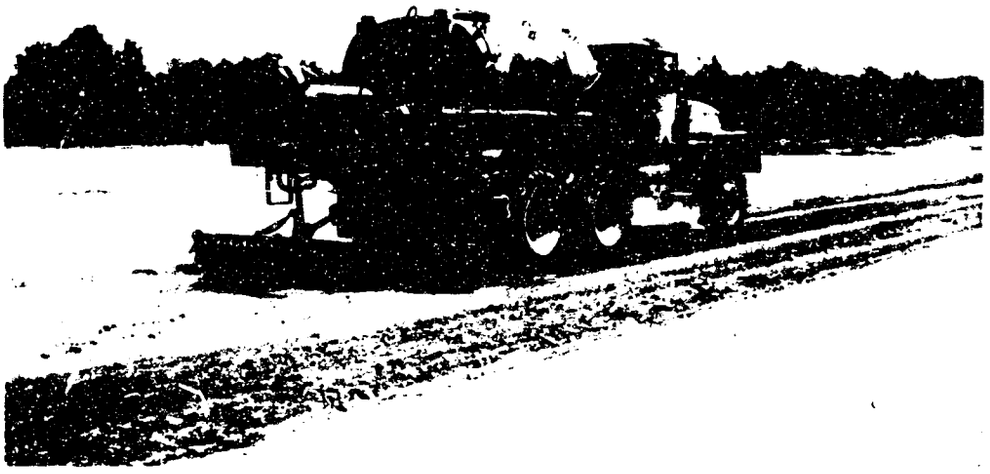
DUST CONTROL MATERIALS

LOADING THE ASPHALT DISTRIBUTOR
FROM THE OPEN TOP DRUMS

US ARMY ARMOR AND ENGINEER BOARD FORT KNOX, KY	USATECOM PROJ NO 7-7-0888-01/02 PHOTO NO 67-1133E

DUST CONTROL MATERIALS

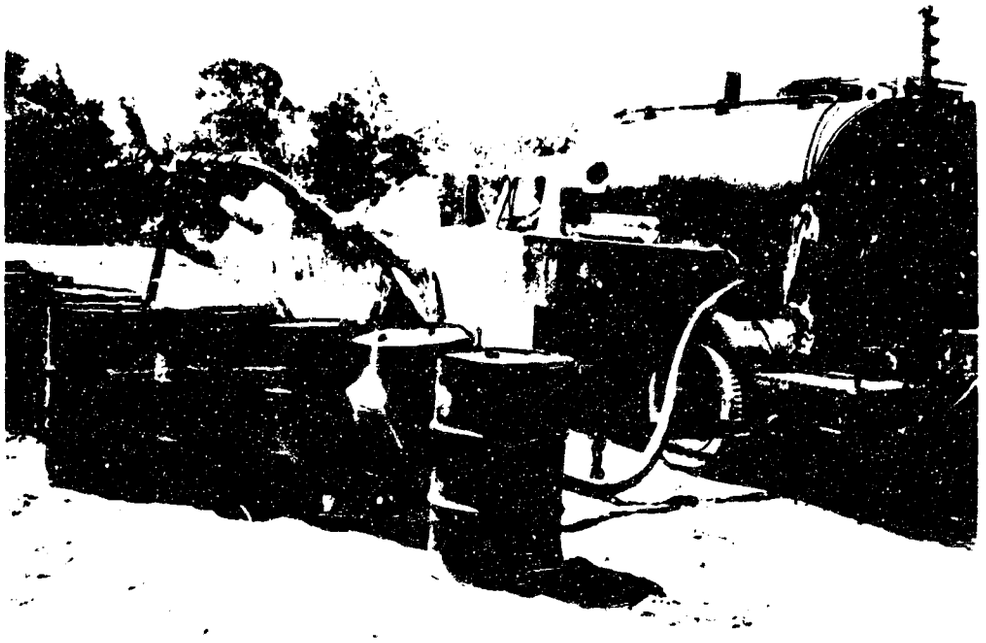
PREWETTING TEST SITE BEFORE EMPLACEMENT



US ARMY ARMOR AND ENGINEER BOARD FORT KNOX, KY	USATECOM PROJ NO 7-7-0888-01/02 PHOTO NO 67-1179D

DUST CONTROL MATERIALS

EMPLACEMENT OF TEST MATERIAL ON TEST SITE



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DUST CONTROL MATERIALS

LOADING CODE A ASPHALT DISTRIBUTOR
FROM BUNG-TYPE DRUMS

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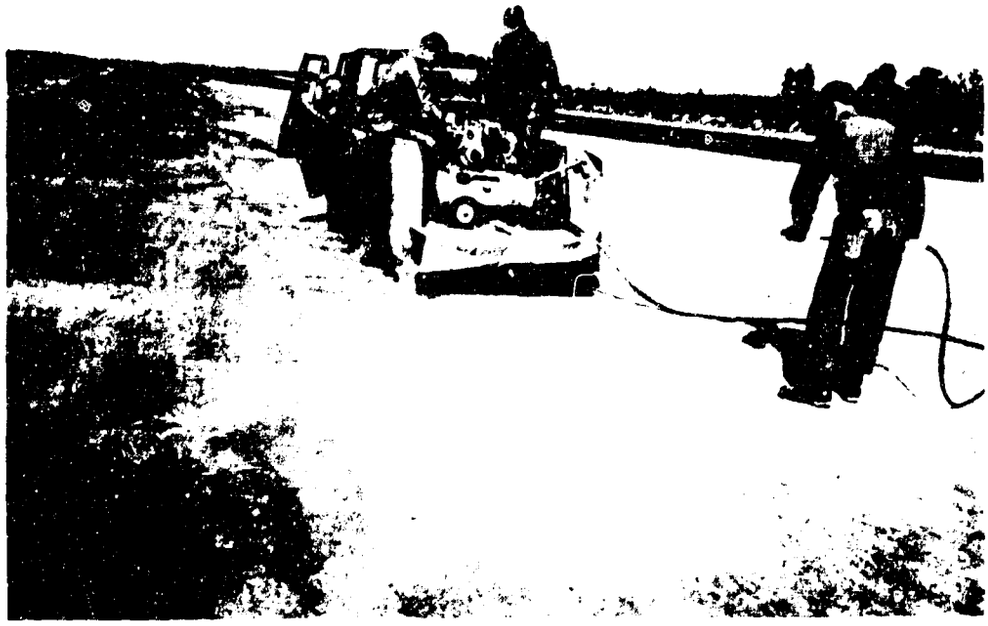
DUST CONTROL MATERIALS

LOADING CODE 4 ASPHALT DISTRIBUTOR
FROM A TANKER TRUCK



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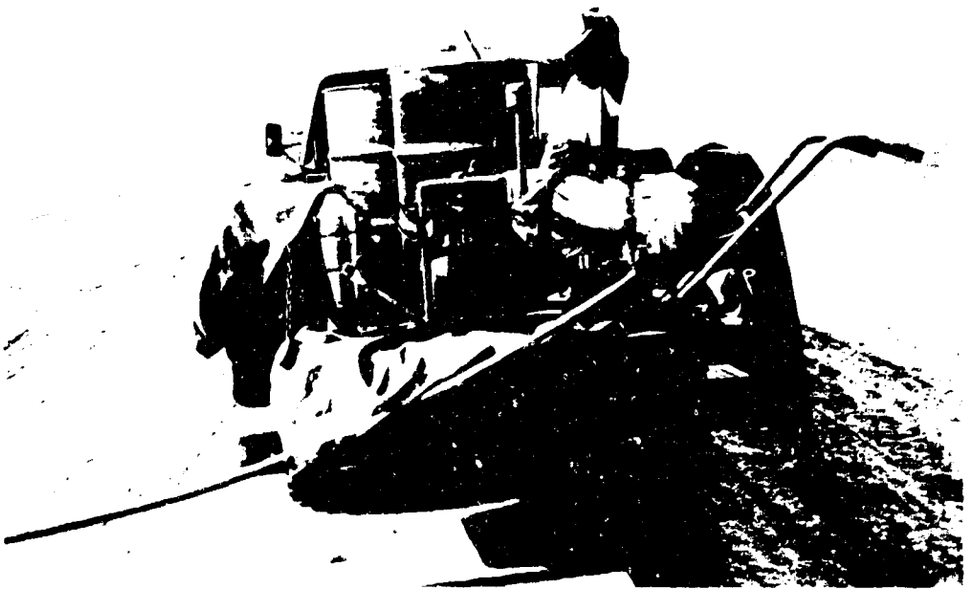
DUST CONTROL MATERIALS

EMPLACEMENT OF TEST MATERIAL
DURING PATCHING OPERATIONS



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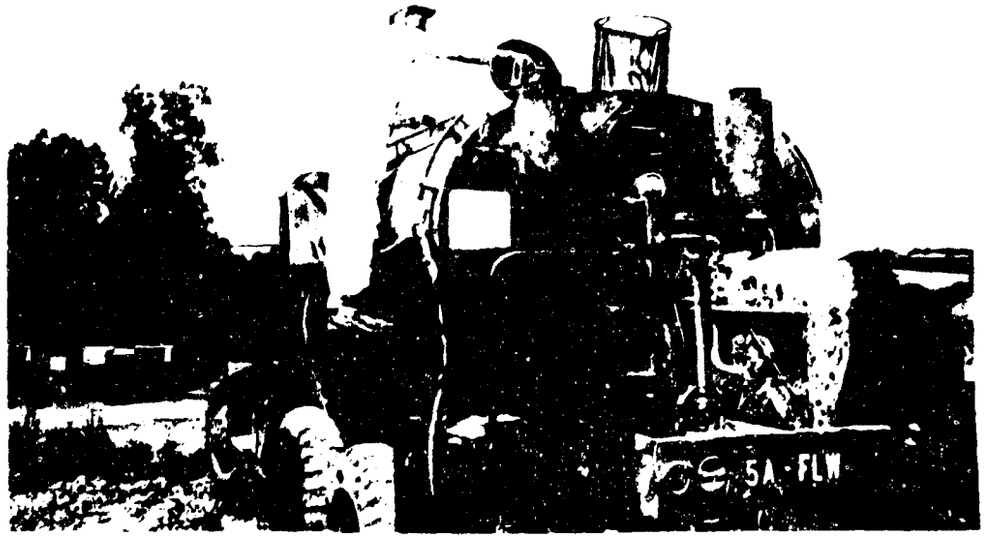
DUST CONTROL MATERIALS

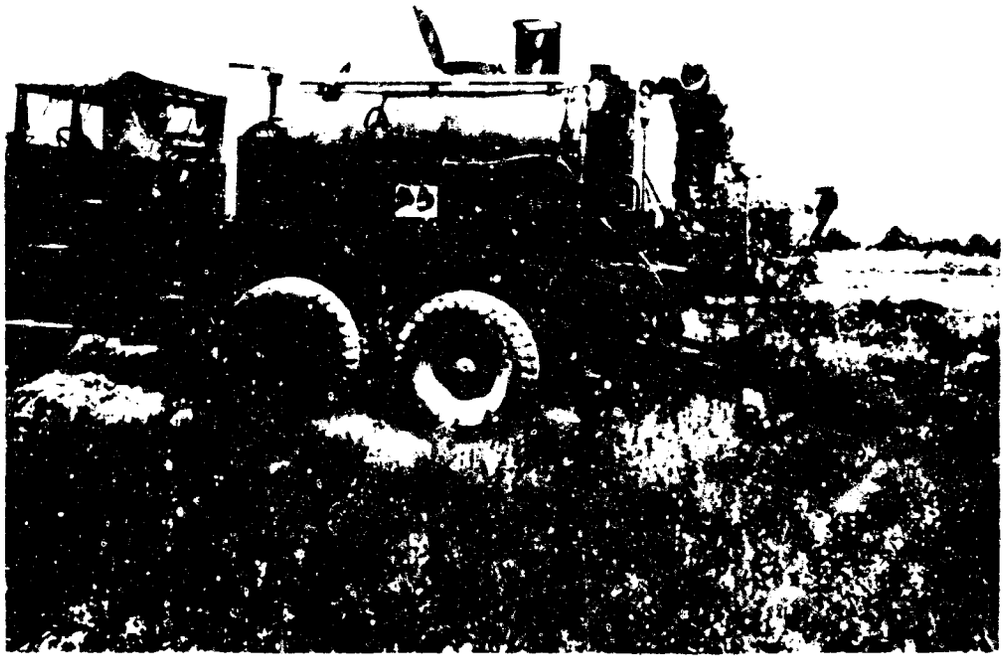
EMPLACEMENT OF TEST MATERIAL
DURING PATCHING OPERATIONS



US ARMY ARMOR AND ENGINEER BOARD FORT KNOX, KY	USATECOM PROJ NO 7-7-0888-01/02 PHOTO NO 67-1179F

DUST CONTROL MATERIALS

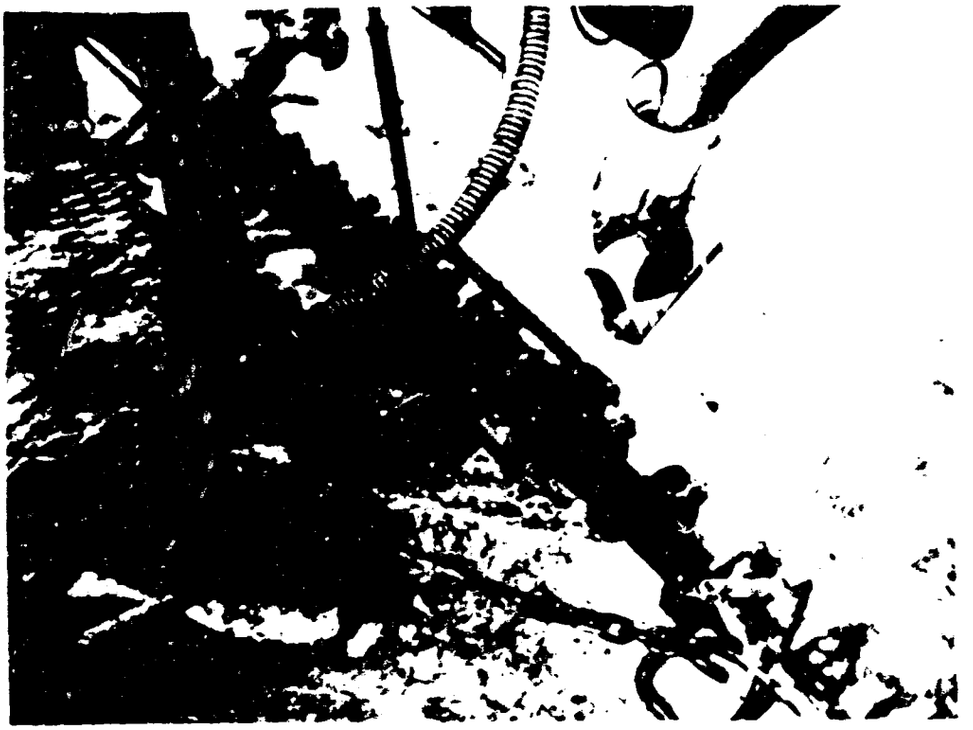
LOADING THE ASPHALT DISTRIBUTOR
DURING THE CLEANING OPERATIONS



US ARMY ARMOR AND ENGINEER BOARD USATECOM PROJ NO 7-7-0888-01/02
FORT KNOX, KY PHOTC NO 67-1179G

DUST CONTROL MATERIALS

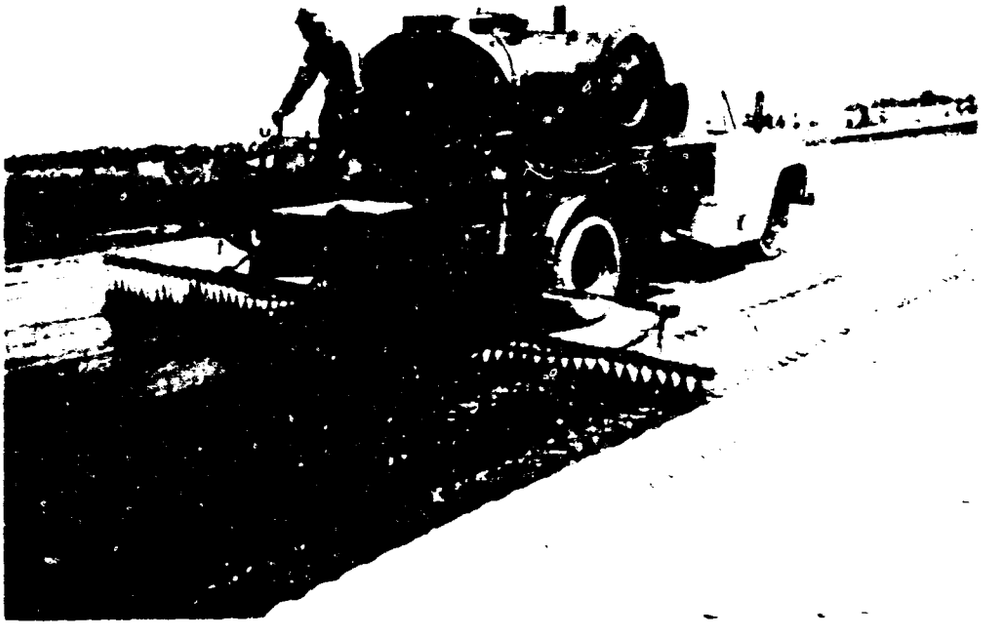
EMPTYING THE ASPHALT DISTRIBUTOR
DURING THE CLEANING OPERATIONS



US ARMY ARMOR AND ENGINEER BOARD FORT KNOX, KY	USATECOM PROJ NO 7-7-0888-01/02 PHOTO NO 67-714

DUST CONTROL MATERIALS

FREEING THE LINKAGE ON THE SPRAY APPARATUS OF THE ASPHALT DISTRIBUTOR



US ARMY ARMOR AND ENGINEER BOARD FORT KNOX, KY	USATECOM PROJ NO 7-7-0888-01/02 PHOTO NO 67-752G

DUST CONTROL MATERIALS

CODE H ASPHALT DISTRIBUTOR WITH DRAG APPARATUS

Incl 3

FINDINGS

The following shows the extent to which the test item met the characteristics specified in the qualitative materiel requirement referenced in para 1b of basic letter.

	REQUIREMENT	DEGREE OF ACHIEVEMENT			REMARKS
		Met	Fell Short	Not Determined	
1.	Performance Characteristics - Dust control material(s) shall:				
1.1	Be effective and operationally usable within 4 hours after application to the surface of all types of soil, and without extensive prior grading, scarifying, or preconditioning of the ground surface.	Codes A, C, and E	Codes B, D, and F		See para 6d(1), 6d(2), 6i(1), and 6i(7)
1.2	Withstand, without failure or peeling, helicopter rotor downwash (10 psf disc loading) and C-130 aircraft propwash (100 mph air velocity).		X		In at least one of the three test sites, each test material was damaged by rotor downwash and/or propwash. See para 6j(3) and 6k(2).

	REQUIREMENT	DEGREE OF ACHIEVEMENT			REMARKS
		Met	Fell Short	Not Determined	
2.	Physical Characteristics - Dust control material(s) shall:				
2.1	Be noncorrosive and noninjurious to metals, alloys, rubber, and plastics, be compatible for use in conjunction with prefabricated landing mats and membrane surfacings and suitable for trafficking by aircraft, ground vehicles, and application equipment without adverse effect to these.			X	Tests were not completed and results were inconclusive.
2.2	Be nontoxic, noninjurious, and noncontaminating to human beings, animals, water supplies, and agricultural areas after being applied.	X			See para 6a(1), 6a(4), and para 6o.

	REQUIREMENT	DEGREE OF ACHIEVEMENT			REMARKS
		Met	Fell Short	Not Determined	
1.3	Be effective, with only minor maintenance, for the following minimum time:				
1.3.1	Six months in non-traffic areas.			X	Testing was terminated before this requirement could be fully evaluated.
1.3.2	Three months in areas subjected to infrequent traffic of ground vehicles or aircraft, such as shoulders and overruns.			X	This requirement was not determined because only the CH-47A helicopter was used to test only one type soil condition. See para 6k(4). There was no further testing on other soil conditions because of project termination
1.3.3	One month in areas trafficked by ground vehicles or aircraft.	Code F	Code A thru E		This requirement was evaluated on clay and silt soil under vehicular traffic tests. All of the test materials except Code F failed to perform satisfactorily. See para 6n(2) and 6n(3).

	REQUIREMENT	DEGREE OF ACHIEVEMENT			REMARKS
		Met	Fell Short	Not Determined	
2.	Physical Characteristics - Dust control material(s) shall:				
2.1	Be noncorrosive and noninjurious to metals, alloys, rubber, and plastics, be compatible for use in conjunction with prefabricated landing mats and membrane surfacings and suitable for trafficking by aircraft, ground vehicles, and application equipment without adverse effect to these.			X	Tests were not completed and results were inconclusive.
2.2	Be nontoxic, noninjurious, and noncontaminating to human beings, animals, water supplies, and agricultural areas after being applied.	X			See para 6a(1), 6a(4), and para 6o.

	REQUIREMENT	DEGREE OF ACHIEVEMENT			REMARKS
		Met	Fell Short	Not Determined	
2.3	Be nonflammable and nonexplosive within specified conditions of handling, storage, and application, and fire retardant after being applied to soil surfaces.	Codes A, B, and C	Codes D, E, and F		Codes D, E, and F are flammable liquids. See para 6a(2).
2.4	Be capable of being stored in other than controlled environmental storage conditions for a minimum of 1-1/2 years, 3 years <u>desirable</u>.			X	No storage test results were obtained due to test termination.
2.5	Weight and volume characteristics of the material shall not exceed 3 pounds per square yard or 0.45 gallons per square yard of ground surface treated on trafficked areas. If material requires dilution with water for application, volume shall not exceed 2 gallons per square yard of ground surface treated.	X			See para 6b and pages 16 through 21, inclosure 1.

	REQUIREMENT	DEGREE OF ACHIEVEMENT			REMARKS
		Met	Fell Short	Not Determined	
2.6	Be available or manufacturable in quantities to treat at least 5 million square yards at a cost not to exceed $0.50 per square yard including material(s) and application equipment.	Codes A, and C thru F	Code B		Code B cost approximately $0.96 per square yard. (See para 6i(8).)
2.7	Be capable of being used, stored, and transported under the following conditions (AR 705-15).				
2.7.1	Use: Intermediate, hot-dry and warm-wet climatic conditions, excluding precipitation, wind greater than 20 knots, and ambient air temperature below 40°F. Desirably be capable of use under cold-dry conditions with ambient air temperatures of 0°F.	X			Service test determination was limited to use under climatic conditions existent at test sites during test. (See para 6g and page 34, inclosure 1.)

REQUIREMENT	DEGREE OF ACHIEVEMENT			REMARKS
	Met	Fell Short	Not Determined	
2.7.2 Storage: Intermediate and high-temperature storage conditions.			X	No storage test results were obtained due to test termination.
3. Training. No special training other than normal MOS and on-the-job training will be required. No equipment will be required solely for training purposes.	X			Military personnel were used to load and unload materials, transfer materials, operate application equipment, grade and clear areas, and lay out test sections. No special training was required. See para 6p.

Note: "X" indicates all test materials.

Incl 4

DEFICIENCIES AND SHORTCOMINGS

1. DEFICIENCIES

Deficiency		Suggested Corrective Action	Remarks
1.1	Codes D, E, and F are considered flammable liquids.	None	No Equipment Performance Report (EPR) was submitted. Code F has a flash point below 175°F; Codes D and E will burn but are not easily ignited. (See para 6a(2).)
1.2	Codes B, D, and F were not operationally usable within 4 hours after application.	None	See EPR No KD-1, KD-1-2 through KD-1-5, and para 6i(7).
1.3	All six test materials were damaged by rotor downwash of a CH-47A helicopter and/or propwash of a C-130E aircraft.	None	See EPR No KD-2, KD-2-2 through KD-2-9; KD-4, KD-4-2 through KD-4-14, KD-4-16, KD-4-17; para 6j(3) and 6k(2).
1.4	All test materials except Code A were not operationally usable after a heavy rainfall.	None	See EPR No KD-5, KD-5-2 through KD-5-4 and para 6n(6).
1.5	Code B exceeded the the maximum allowable cost of $0.50 per square yard.	None	See para 6i(8).

Deficiency	Suggested Corrective Action	Remarks
1.6 Code A thru E failed under vehicular traffic on clay and silt soil.	None	See para 6n(2) and 6n(3). No EPR was submitted.

2. SHORTCOMINGS

Shortcoming	Suggested Corrective Action	Remarks
2.1 Vegetation and ants ruptured Codes A, B, and C.	None	See EPR No KD-3 and para 6n(4).
2.2 Code A become tacky during an average surface temperature of 120°F and stuck to the tire of a parked truck.	None	See EPR No KD-6 and para 6n(5).

NOTE: EPR No KD-4-15 was submitted for "information only"; requires no correction action; therefore, has been omitted from this inclosure.

MANUFACTURERS' CODE SHEET

USATECOM PROJECT NO 7-7-0888-01/02

Code	Product	Manufacturer
A	UCAR-131	Union Carbide Corp New York, New York
B	Fastbond-30 Contact Cement	Minnesota Mining and Manufacturing Company St Paul, Minnesota
C	Soil Gard	ALCO Chemical Corp Philadelphia, Pennsylvania
D	SC-70 Cutback Asphalt	Most petroleum firms
E	Dustrol	Mobile Oil Company Kansas City, Missouri
F	Peneprime	Empire Petroleum Company Denver, Colorado
G	Binks Spraying System	Sherman Williams Company Vicksburg, Mississippi
H	Etnyre Black Topper	Allied Equipment Company Jackson, Mississippi

This code sheet will not be distributed outside the Department of Defense.

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
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	2b. GROUP

3. REPORT TITLE

INTEGRATED ENGINEERING AND SERVICE TESTS OF DUST CONTROL MATERIALS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Report - April through October 1967

5. AUTHOR(S) (Last name, first name, initial)

CRAIG, Randall C., 1LT, CE
BAKER, Mendell K., SP5, Scientific and Engineering
LAUGHLIN, R. C., Mr.

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
21 March 1968	~~84~~ 87	7

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. RDT&E 1G643324D55603	US Army Test and Evaluation Command 7-7-0888-01/02
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
This report also includes test results obtained from USAGETA and USAEWES	US Army Engineer Waterways Experiment Station P. O. Box 631 Vicksburg, Mississippi 39181

13. ABSTRACT Test objectives were to determine the technical performance and safety characteristics of the dust control materials as described in the QMR; the suitability of the materials for Army use; and the capability of the USAEWES procured (and military standard) distributors to meet performance requirements of the QMR for dispersing the test materials. The materials (three asphalt type and three emulsion-type) were emplaced on airfields at three test sites with different type soils, viz, Dyess AFB (clay); Eglin AFB (sand); and Fort Leonard Wood (silt). Each of the test materials was damaged by rotor downwash of a CH-47A Helicopter and/or propwash of a C-130E Aircraft. Each of the test materials failed to meet two or more essential requirements of the QMR; therefore, the test was terminated. It was concluded that the test materials were unsuitable for Army use; the distributors were capable of adequately dispersing test materials when modified to provide lubricant for the pump shaft bearings and were throughly cleaned after use; and the top-opening type drums were suitable during storage and handling operations; however, with emulsion-type materials a polyethelene liner is required under the lid. USAARENBD recommended that all six test materials be considered unsuitable for Army use pending correction of all deficiencies (and the shortcomings if practicable) in inclosure 4 of the report; the distributor be modified, and the top-opening drums used for emulsion-type materials be provided with polyethelene linings under the lids. It was further recommended that any future development of dust control materials incorporate correction of deficiencies (and shortcomings if practicable) listed in inclosure 4 of the report.

DD FORM 1 JAN 64 1473

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Dust Control Materials Water-dispersed Air-drying adhesive Cutback asphalt High-boiling aromatic oil Liquid palliatives Distributor						

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